Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Amendment of Part 15 regarding new requirements and measurement guidelines for Access Broadband over Power Line Systems	)	ET Docket No. 04-37
	)	
	)	
Carrier Current Systems, including Broadband over Power Line Systems	)	ET Docket No. 03-104

REPORT AND ORDER

Adopted: October 14, 2004 **Released: October 28, 2004**

By the Commission: Chairman Powell and Commissioner Abernathy issuing a joint statement; Commissioners Martin and Adelstein issuing separate statements; Commissioner Copps approving in part, dissenting in part and issuing a statement.

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I. INTRODUCTION

1. In this Report and Order, we adopt new rules for Access Broadband over Power Line (Access BPL) systems, a new type of carrier current technology that provides access to high speed broadband services using electric utility companies' power lines. This new technology offers the potential for the establishment of a significant new medium for extending broadband access to American homes and businesses. Given that power lines reach virtually every residence and business in every community and geographic area in this country, Access BPL service could be made available nearly everywhere. This new broadband delivery medium could also serve to introduce additional competition to existing cable, DSL, and other broadband services. In addition, the National Telecommunications and Information Administration (NTIA) has undertaken a significant effort to both study Access BPL technology, including its operating characteristics and interference potential, and to make specific recommendations to the Commission for policies to encourage its implementation and to manage its interference potential.[1] Our staff has worked closely with NTIA on this matter and the policy decisions and rules we are adopting herein reflect this cooperation and embody many of NTIA's recommendations.

2. Along with NTIA, we recognize the concerns of authorized radio service users in both the private and government sectors for the need to ensure that radio frequency (RF) energy from BPL signals on power lines does not cause harmful interference to licensed radio services. The record and our investigations indicate that BPL network systems can generally be configured and managed to minimize and/or eliminate this harmful interference potential. Our goals in developing the rules for Access BPL set forth herein are therefore to provide a framework that will both facilitate the rapid introduction and development of BPL systems and protect licensed radio services from harmful interference. Specifically, we are adopting: 1) new operational requirements for Access BPL to promote avoidance and resolution of harmful interference; 2) new administrative requirements to aid in identifying Access BPL installations; and 3) specific measurement guidelines and certification requirements to ensure accurate and repeatable evaluations of emissions from Access BPL and all other carrier current systems. We believe these actions will promote the development of BPL systems by removing regulatory uncertainties for BPL operators and equipment manufacturers while ensuring that licensed radio services are protected from harmful interference.

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[1] *See* comments of NTIA at 6. The Federal Communications Commission, which is an independent agency, administers non-Federal Government spectrum under the Communications Act of 1934, as amended, *see* 47 U.S.C § 151, *et seq*. NTIA, which is an operating unit of the Department of Commerce, administers Federal Government spectrum and is responsible for administering the communications and information functions of the Executive branch of the Federal Government, *see* 47 C.F.R. § 2.105(a) and Executive Order 12046 of March 26, 1978. NTIA also approves the spectrum needs of new systems for use by Federal departments and agencies and maintains the Federal Government Table of Frequency Allocations in its *Manual of Regulations and Procedures for Federal Radio Frequency Management (NTIA Manual)*. In addition to its comments, NTIA has conducted an extensive technical study and analysis of Access BPL technology. This study is in two phases. Phase 1 examined the interference risks to radio reception in the immediate vicinity of overhead power lines used by Access BPL systems and suggests means for reducing these risks and techniques for mitigating local interference if it should occur. NTIA published the findings of its Phase 1 study in "Potential Interference From Broadband Over Power Lind (BPL) Systems to Federal Government Radiocommuncations at 1.7 – 80 MHz, Phase 1 Study," NTIA Report 04-413, April 2004 (NTIA Phase 1 Study). In Phase 2, which is not yet complete, NTIA is evaluating the effectiveness of its Phase 1 recommendations and addressing potential interference via ionospheric propagation of BPL emissions from mature large-scale deployments of BPL networks. NTIA's comments make reference to the NTIA Phase 1 Study, as supplemented by the preliminary elements of its Phase 2 report, which are presented in a technical appendix to those comments. NTIA also provided pertinent results of its further studies of special protection requirements (NTIA letter of September 13, 2004) as well as transmission of identification codes and measurement details (NTIA letter of September 24, 2004).

II. BACKGROUND

3. Carrier current systems use alternating current (AC) electric power lines to carry communications by coupling very low power RF signals onto the AC electric wiring.[2] Traditionally, these systems have included amplitude modulated (AM) radio systems on school campuses and devices intended for the home, such as intercom systems and remote controls for electrical appliances and lamps.[3] Carrier current systems operate on an unlicensed basis under Part 15 of the Commission's rules.[4] As a general condition of operation, Part 15 devices may not cause harmful interference to authorized radio services and must accept any interference that they receive.[5]

4. Until recently, carrier current devices generally operated on frequencies below 2 MHz and with relatively limited communications capabilities. In the last few years, the availability of faster digital processing capabilities and the development of sophisticated modulation schemes have allowed the development of new designs for carrier current devices that are capable of overcoming earlier technical obstacles caused by the inherent noise and impedance mismatch of power lines. These new designs have led to the development of BPL systems that use spread spectrum or multiple carrier techniques with highly adaptive algorithms to effectively counter the noise in the line.

5. The new low-power, unlicensed BPL systems provide high speed digital communications capabilities by coupling RF energy onto either the power lines inside a building ("In-House BPL") or onto the medium voltage power delivery lines ("Access BPL").[6] In-House BPL systems use the electrical outlets available within a building to transfer information between computers and between other home electronic devices, eliminating the need to install new wires between devices, and hence facilitating the implementation of home networks.[7] Access BPL systems deliver high speed Internet and other

[2] A carrier current system is defined as a system, or part of a system, that transmits radio frequency energy by conduction over an electric power line to a receiver also connected to the same power line. *See* 47 C.F.R. § 15.3(f).

[3] Campus radio systems have been operating for over fifty years in the United States at many universities as unlicensed broadcast radio stations in the AM Broadcast band, *see* 47 C.F.R. § 15.221. Initially, the receiver and signal source were attached to the same electric power line. After the advent of the transistor radio, receivers are sensitive enough to be able to pick up enough radiated signal for adequate reception when placed next to the electric power line in a dormitory or other locations on a campus' electric power lines. *See also, e.g.*, X-10 products for home automation at http://www.X10.com, and products conforming to ANSI/EIA-600.31-97 *Power Line Physical Layer and Medium Specification* (CEBus Standard).

[4] *See* 47 C.F.R. §§ 15.3(f), 15.5, 15.31(d), (f), (g) and (h), 15.33(b)(2), 15.101(a) and (f), 15.107(a)-(c), 15.109(a), (b), (e) and (g), 15.201(a), 15.207(c), 15.209(a) and 15.221.

[5] 47 C.F.R. § 15.5. Under these rules, operators of Access BPL systems are responsible for eliminating any harmful interference that may occur or must cease operation upon notification by a Commission representative that the device is causing harmful interference.

[6] In-House BPL uses the 110 volt power wiring inside a residence or business to carry information within a structure. Access BPL typically uses the medium voltage exterior power distribution network lines (carrying between 1,000 to 40,000 volts) as a transmission medium to bring high-speed communications services, *e.g.*, the Internet and other broadband services, to neighborhoods from where they are delivered to users.

[7] Home networks allow information to be transferred among computers, set-top boxes, information appliances and consumer electronics devices. Applications of home networking include, for example, shared Internet access, shared printing, file sharing between personal computers, and device control.

broadband services to homes and businesses. In addition, electric utility companies can use Access BPL systems to monitor, and thereby more effectively manage, their electric power distribution operations. Because Access BPL capability can be made available in conjunction with the delivery of electric power, it may provide an effective means for "last-mile" delivery of broadband services and may offer a competitive alternative to digital subscriber line (DSL), cable modem services and other high speed Internet access technologies.

6. Access BPL systems carry high speed data signals to neighborhoods from a point where there is a connection to a telecommunications network. The point of network connection may be at a power substation or at an intermediate point between a substation and network terminations, depending on the network topology. Within a residential neighborhood, some system implementations complete the connection between the medium voltage lines and subscriber homes or businesses by using wireless links.[8] Other implementations employ a coupler or bridge circuit module at the low-voltage distribution transformers to transfer the Access BPL signals across (thereby bypassing) these devices.[9] In such systems, the BPL signals are brought into homes or businesses over the exterior power supply cable from the coupler/bridges, either directly, or via Access BPL adaptor modules.[10] Typically, the medium voltage lines are carried overhead on transmission poles or tower mountings; however, in a large number of locations, and in newer subdivisions and neighborhoods, these lines are enclosed in underground conduits and the distribution transformers are mounted above ground on a pad, inside a metal housing.

7. The interference concern regarding BPL operation arises from the fact that electric power lines are not shielded and therefore portions of any RF energy they may carry can be radiated. While the power distribution management devices, such as transformers, and sometimes underground placement of lines that are characteristic of many electric utility systems tend to substantially diminish the effectiveness of these systems as radiators of RF energy, the potential for significant radiation of RF energy from utility systems that carry RF signals nonetheless remains. This "signal leakage," which has for years made possible the reception of carrier current radio stations at colleges, universities and other institutions without a connection to the power line, can become harmful interference if not carefully managed. That is, radio systems using the same frequency bands as those on which local Access BPL signals are transmitted could possibly receive harmful interference from such signal leakage if adequate safeguards are not in place.

8. Most Access BPL systems that are currently deployed operate in the range from 2 MHz to 50 MHz, with very low-power signals that are spread over a broad range of frequencies. These frequencies are also used by licensed radio services that must be protected from harmful interference under the Commission's Part 15 rules for unlicensed devices. In the radio spectrum below 50 MHz, incumbent authorized radio services include fixed, land mobile, aeronautical mobile, maritime mobile, radiolocation, broadcast radio, amateur radio terrestrial and satellite, and radio-astronomy. Users of this spectrum include, for example, public safety and Federal government agencies, aeronautical navigation licensees, amateur radio operators, international broadcasting stations, and citizens band radio operators.

[8] *See e.g.*, http://www.amperion.com/products.asp.

[9] Low voltage transformers are poor conduits for high-frequency digital signals, as they are intended to conduct 60 Hz electric power.

[10] *See e.g.*, http://www.currenttechnologies.com/products.asp; http://www.mainnet-plc.com.

9. The Part 15 rules for carrier current systems currently specify radiated and conducted emission limits for devices operating below 30 MHz and above 30 MHz.[11] Carrier current systems operating from 9 kHz to 30 MHz are subject to radiated emission limits on emissions from any part of the wiring or power network connected to the RF power source.[12] For carrier current systems that contain their fundamental emission within the standard AM broadcast band of 535 to 1705 kHz and are intended to be received using standard AM broadcast receivers, there is no limit on conducted emissions.[13] All other carrier current systems operating below 30 MHz are subject to a conducted emission limit only within the AM broadcast band.[14] Carrier current devices operating above 30 MHz must meet the radiated emission limits of Section 15.109(a), (b) or (g) for digital devices, which are further divided into two types.[15] Class A equipment includes devices marketed for use in a commercial, industrial or business environment, excluding devices which are marketed for use by the general public or are intended to be used in the home.[16] Class B equipment includes devices marketed for use in a residential environment, notwithstanding use in commercial, business and industrial environments.[17] The rules require Access BPL systems to comply with the limits for Class A or B devices depending on whether they are marketed for use in a commercial, industrial or business environment on the one hand or for use by the general public or in the home on the other.[18] Under this Class A/Class B regime, Access BPL systems that operate on medium voltage lines external to residential environments are considered Class A devices. Carrier current devices that do not operate on frequencies below 30 MHz are subject to the general conducted emission limits below 30 MHz.[19] The existing Part 15 rules also address power line carrier systems, which are low-speed carrier current systems operating between 10 kHz and 490 kHz, used by an electric public utility entity for protective relaying, telemetry, etc., for general supervision of the power

[11] Radiated emissions consist of desired or undesired electromagnetic energy, in the form of electric and/or magnetic fields, propagated through space. Conducted emissions consist of desired or undesired electromagnetic energy propagated along a conductor. *See* the *American National Standard Dictionary for Technologies of Electromagnetic Compatibility (EMC), Electromagnetic Pulse (EMP), and Electrostatic Discharge (ESD)*,ANSI C63.14-1998, at §§ 4.62 and 4.275.

[12] *See* 47 C.F.R. § 15.109(e). Radiated emission limits vary with frequencies; for example, in the 1705 kHz to 30 MHz region, the radiated emission limit is 30 μV/meter, at a measurement distance of 30 meters.

[13] A conducted limit was not considered practical when the rules were formulated for campus radio systems, since these systems intentionally couple RF energy onto the power line. *See* 47 C.F.R. § 15.107(c). Carrier current systems whose fundamental emission is intended for reception on AM broadcast receivers avoid interference to AM radio service by operating on a frequency that is not used by a local AM station.

[14] For the protection of the AM Broadcast service, the device is subject to a conducted emission limit of 1000 μV in the AM broadcast band (from 535 to 1705 kHz). *See* 47 C.F.R. §§ 15.107(c)(2) and 15.221. This provision does not apply to power line carrier systems, which are subject to 47 C.F.R. § 15.113.

[15] *See* 47 C.F.R. § 15.109(a), (b) and (e).

[16] *See* 47 C.F.R. § 15.3(h).

[17] *See* 47 C.F.R. § 15.3(i).

[18] The radiated emission limits for Class A equipment are approximately 10 dB higher than the radiated emission limits for Class B equipment. *See* 47 C.F.R § 15.109(a), (b) and (g).

[19] *See* 47 C.F.R. § 15.107(a)-(c). Conducted limits are generally specified from 150 kHz to 30 MHz only, because signals below 30 MHz have wavelengths greater than 10 meters and lower propagation losses, and can take special advantage of long stretches of electrical wiring.

system.[20] Because of their specialized use and operating frequency range, power line carrier systems are not subject to specific emission limits as are general carrier current systems.[21]

10. In April 2003, the Commission issued a *Notice of Inquiry (Inquiry)* on BPL technologies and systems. The Commission solicited comments to assist in reviewing its Part 15 rules to encourage the deployment of BPL systems while ensuring protection to the licensed services.[22] Based on comments received in response to the *Inquiry,* in February 2004, the Commission issued a *Notice of Proposed Rule Making (Notice)*, in which it proposed rules for Access BPL systems that were intended to 1) remove regulatory uncertainty for BPL operators, thereby facilitating the introduction and use of this promising new technology, and 2) ensure that licensed services are protected from harmful interference by BPL operations.[23] In the *Notice*, the Commission recognized the potential that Access BPL holds in terms of a new method of delivery of broadband services to residential, institutional, and commercial users. The Commission further noted that Access BPL is being developed worldwide, and stated that encouraging the deployment of this technology in the United States will support globalization of products and services, promote continued U.S. leadership in broadband technology, and bring important benefits to the American public.[24] The Commission sought comments on proposals in five broad areas related to Access BPL systems and protection of authorized services: 1) a definition of Access BPL; 2) the Part 15 emissions limits for Access BPL; 3) additional technical and operational requirements for interference mitigation and resolution; 4) the notification of Access BPL locations and operational characteristics in a database to facilitate interference mitigation and avoidance measures; and 4) the appropriate measurement procedures to accurately assess Access BPL emissions and emissions from all other carrier current systems.[25]

11. Over a thousand comments and replies were received in response to the *Notice*. The NTIA has been particularly helpful in suggesting ways to have an orderly and timely deployment of BPL devices in a manner that mitigates harmful interference to licensed radio services. The NTIA submitted an extensive study on the interference potential of Access BPL systems to federal government systems.[26] This study helped confirm the localized nature of potential harmful interference from Access BPL systems and that aggregation of Access BPL emissions at ground-based radio receiver antennas will not increase interference risks. Subsequently, NTIA submitted comments accompanied by a Technical Appendix.[27] NTIA focuses on the need for rules that responsibly address both interference concerns and

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[20] See 47 C.F.R. § 15.3(t). A carrier current system operated by an electric utility to control the utility's electrical grid is defined as a power line carrier system in the rules.

[21] Power line carrier systems are only subject to 47 C.F.R. § 15.113.

[22] *See Inquiry Regarding Carrier Current Systems, including Broadband over Power Line Systems, Notice of Inquiry (Inquiry)*, ET Docket No. 03-104, 18 FCC Rcd 8498 (2003).

[23] *See In the Matter of Carrier Current Systems, including Broadband over Power Line Systems and Amendment of Part 15 regarding new requirements and measurement guidelines for Access Broadband over Power Line Systems, Notice of Proposed Rulemaking (Notice)*, ET Docket Nos. 03-104 and 04-37, 19 FCC Rcd 3335 (2004).

[24] *Id.*, at ¶30 and footnote 87.

[25] *Id.*, at ¶31.

[26] *See* NTIA Report 04-413, *Potential Interference From Broadband Over Power Line (BPL) Systems To Federal Government Radiocommunications at 1.7-80 MHz, Phase 1 Study, Volume I*, National Telecommunications and Information Administration, filed April 27, 2004.

[27] *See* NTIA Comments, filed June 8, 2004.

BPL operational requirements. It urges the Commission to promptly adopt effective new technical rules that will enable BPL proponents to develop and implement the necessary new design features and operating practices for addressing interference concerns and to obtain new equipment authorizations so as to contribute significantly toward fulfillment of the President's vision for universal affordable broadband Internet access.[28] These comments and our decisions are discussed below.

III. DISCUSSION

12. The deployment of broadband delivery capabilities to provide all Americans with access to affordable high speed Internet and data services is one of the most important challenges currently facing the Commission and the communications industry. This challenge is being met by many different service providers with a wide variety of technologies and delivery media, including, for example, DSL service on conventional telephone lines, cable modem services, dedicated high speed lines, unlicensed wireless internet access services, and the fixed and mobile radio services. The different options for obtaining broadband services allow consumers and businesses to select the type(s) of service that best meet their individual needs. In addition, the open market for such services promotes competition that both makes service affordable and provides incentives for quality service and innovation in new technologies and service features.

13. We believe that the widespread introduction of Access BPL service would further our goals for broadband service consistent with the challenges indicated above. This new technology offers the potential to give rise to a major new medium for broadband service delivery. Services provided on Access BPL could offer high speed Internet and data communications that compete with, complement, or extend the broadband services provided on existing media. Given the ubiquitous nature of the electric power network, Access BPL could conceivably also offer these services to virtually every element of the broadband market, including residential, institutional, and commercial users. In addition, it is possible that Access BPL could provide a means to expedite the availability of broadband Internet service to consumers and business in rural and other underserved areas. We also find that encouraging the deployment of the technology in the United States will support globalization of products and services, promote continued U.S. leadership in broadband technology, and bring important benefits to the American public.[29]

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[28] *See* comments of NTIA at iv.

[29] On January 8, 2004, the European Commission (EC) requested the European Committee for Electrotechnical Standardization (CENELEC) and the European Telecommunications Standard Institute (ETSI) to define a technical specification providing test methods and limits for radiated (and possibly consistent conducted) emissions compatible with state of the art power line communication infrastructure, in the framework of Mandate M313 given in August 2001 to these organizations (see http://europa.eu.int/comm/enterprise/electr_equipment/emc/interep313.htm.) This technical specification will be an intermediate step in defining the technical conditions for compliance with EC regulations. In addition, on January 21, 2004, the Japanese Ministry of Public Management, Home Affairs, Posts and Telecommunications (MPHPT) issued a press release announcing a new policy that will permit the establishment of experimental high-speed power line communications facilities in Japan. *See MPHPT decides on policy concerning permits for establishing experimental high-speed power line communications facilities, Press Release, Jan. 21, 2004* at http://www.soumu.go.jp/s-news/2004/040121_1.html and http://www.soumu.go.jp/ joho_tsusin/ eng/Releases/Telecommunications/news040121_2.html. We further note that in Canada, the City of Sault Ste. Marie, Ontario, had initiated a program to deploy BPL service, beginning in March 2004, *Communications Daily, Vol. 24, No. 24, February 5, 2004.*

14. The supporting comments of parties with a wide range of business interests relating to broadband service reflect the potential benefits of BPL in providing Internet and data services to our citizens and economy. These parties represent communications, manufacturing, government and other interests, including current broadband service providers, rural telecommunications providers, public safety providers, local municipalities, Access BPL equipment manufacturers, consumer electronics manufacturers, electric power utility companies, home security monitoring services, and radio service licensees.[30] For example, AT&T Corp. (AT&T) and Current Technologies (Current) submit that Access BPL can bring an end to the broadband duopoly of cable modem and DSL service.[31] Current specifically indicates that Americans need multiple ways to bring reliable economical broadband access to homes and businesses- not only to reach places that are not currently served, but also to accelerate competition in areas where broadband access is currently available. The Association of Public-Safety Communications Officials-International, Inc. and the National Public Safety Telecommunications Council (APCO/NPSTC) and the Central Station Alarm Association (CSAA) state that this new medium has the potential to bring Internet and high speed broadband access to persons and locations that currently have limited choice for such services.[32] The Consumer Electronics Association (CEA) submits that Access BPL will advance consumer use of new technologies and products such as home networks.[33] It further states that Access BPL could facilitate less expensive and more convenient monitoring and other functions that may prove valuable to consumers and businesses. The National Rural Telecommunications Cooperative and the National Rural Electric Cooperative Association (NRTC/NRECA) in joint comments submit that they support our efforts to expedite the availability of rural broadband Internet service over multiple delivery platforms and the goal of rapid BPL build out.[34] At the same time, they caution that BPL deployment is years from economic feasibility in rural areas.

15. Electric utility services and Access BPL system developers, including Cinergy Corp. (Cinergy), Consolidated Edison Company of New York, Inc. (Con Edison), Current, Oncor Delivery Electric Company (Oncor), and Southern., Southern Telecom Inc., and Southern Company Services, Inc. (collectively "Southern") anticipate that Access BPL will enable a variety of more sophisticated power distribution applications, including automated outage detection and restoration confirmation, remote monitoring and operation of switches and transformers, more efficient demand-side management programs and power quality monitoring to detect faulty components before they fail.[35] Southern offers that Access BPL offers a unique communication tool for utilities that will support functions such as remote reclosure operations of circuit breakers, power quality monitoring, automated meter reading, automatic connect and disconnect, system monitoring, and video surveillance of utility property. The

[30] Parties supporting the introduction of BPL and providing statements relating to its potential benefits include Ambient Corporation (Ambient), the American Petroleum Institute (API), AT&T, APCO/NPSTC, the CEA, the CSAA, Cinergy Corp. (Cinergy), the City of Manassas Virginia, Current, Duke Energy Corporation (Duke Energy), Main.Net Communications, Ltd. (Main.Net), the National Telecommunications and Information Administration, the National Rural Telecommunications Cooperative and the National Rural Electric Cooperative Association (NRTC/NRECA), Oncor Electric Delivery Company (Oncor), PPL Telcom LLC (PPL Telcom), Progress Energy, Inc. (Progress Energy) and Southern., Southern Telecom Inc., and Southern Company Services, Inc. (collectively "Southern").

[31] See comments of AT&T at 3; Current at 9.

[32] *See* comments of APCO/NPSTC at 2; CSAA at 1.

[33] *See* comments of CEA at 4.

[34] *See* comments of NRTC/NRECA at 4-5.

[35] *See* comments of Cinergy at 2; Current at 1-2; Oncor at 1; Southern at 3-4.

NTIA similarly submits that widespread deployment of Access BPL will make it possible to speed detection and diagnosis of electrical system failures. It states that, indeed, the rules for Access BPL must anticipate the possibility that apart from providing commercial broadband services, many electric utilities will eventually deploy BPL technology in order to realize the associated infrastructure benefits. NTIA further states that deployment of Access BPL will also motivate electric power utilities to upgrade their power distribution plant so as to reduce power line noise levels.[36]

16. Several parties do, however, express concern that the potential benefits of Access BPL not come at the cost of new interference to licensed radio service.[37] For example, APCO/NPSTC, APCO Region 21, and the International Municipal Signal Association (IMSA), which operates radio call boxes used by the public to call for fire, police, ambulance, road service or other assistance, submit that there are public safety systems in the HF (2-7 MHz), low VHF (30-50 MHz), and VHF (72-76 MHz) bands that must be protected from harmful interference.[38] Global2Way Acquisition, LLC (Global), which operates a low power communications service for intra/interstate trucking companies on HF frequencies under secondary licenses, asks that that we proceed carefully on Access BPL, balancing the laudable goal of providing new services against the potential harm to existing services. The International Municipal Signal Association (IMSA), which operates radio call boxes used by the public to call for fire, police, ambulance, road service or other assistance, requests that we exclude the 73-74 MHz and 75.4-76 MHz bands used by these facilities from Access BPL operation in order to protect them from harmful interference.[39]

17. Aeronautical Radio, Inc. (ARINC) and the Boeing Company (Boeing) request that Access BPL not be permitted to operate in the frequency bands that are used by the aeronautical radio service. The North American Short Wave Association (NASWA) requests that we protect international broadcasting services in the 5.9-26.1 MHz frequency range.[40] Shipcom LLC (Shipcom), which operates several Maritime Public Coast (MPC) stations on frequencies in the 2-25 MHz range, submits that its facilities would be especially susceptible to BPL interference because the receiving antennas of its stations are mounted very high. To avoid such interference, it requests that we establish BPL-free zones around MPC stations. Bell South Corporation (Bell South) and Verizon Communications, Inc. (Verizon) are concerned that Access BPL could cause harmful interference with telephone network and DSL services because power lines are parallel to telephone wires, which are also unshielded, and so could receive harmful interference.[41] Alan Dixon is concerned the BPL could cause harmful interference to Citizen's Band (CB) radio service on 27 MHz frequencies.

18. The Association for Maximum Service Television, Inc. (MSTV) urges the Commission to limit Access BPL to frequencies below 50 MHz, and avoid operations in the low VHF TV band.[42] The Society

[36] *See* comments of NTIA at 4.

[37] *See* comments of APCO/NPSTC at 2; AT&T at 2; Global2Way Acquisition LLC (Global) at 2; International Municipal Signal Association (IMSA) at 5; Potomac Valley Radio Club (PVRC) at 3.

[38] *See* comments of APCO/NPSTC at 2; APCO Region 21 at 4. The High Frequency (HF) band covers frequencies from 3 to 30 MHz. The Very High Frequency (VHF) band covers frequencies from 30 to 300 MHz.

[39] *See* comments of IMSA at 5.

[40] *See* comments of NASWA at 2.

[41] *See* comments of Bell South at 6; Verizon at 2-3.

[42] *See* comments of MSTV at 2.

of Broadcast Engineers (SBE) is concerned that BPL operations could cause harmful interference to low VHF band DTV stations (channels 2-6) because the service threshold for those channels is just 28 dBμ, or 25.1 μV/m.[43] It therefore submits that low band VHF DTV stations will not be able to serve viewers if Access BPL is allowed to operate on frequencies up to 80 MHz, and that even limiting BPL to a maximum of 50 MHz might not be satisfactory because of the likely generation of harmonics in BPL equipment. SBE further submits that BPL operations could interfere with Broadcast Auxiliary service (BAS) remote pickup stations and low power auxiliary stations operating on frequencies between 25.85 and 26.48 MHz. In addition, SBE expresses concern that BPL operations could adversely affect Emergency Alert System (EAS) transmissions by AM radio stations at 535 to 1705 kHz, by EAS Primary Entry Point (PEP) stations on frequencies between 2-20 MHz, and by low band VHF EAS stations in the 39.48 MHz (California) and 44.43 MHz (Illinois) bands. The National Academy of Sciences/National Research Council's Committee on Radio Frequency (NAS/CORF) submits that radio astronomy allocations in the HF and low VHF regions need to be protected from Access BPL operations.[44]

19. NTIA recommends that we adopt several new Access BPL rule elements that would couple with our proposed rules to reduce risks of harmful interference from Access BPL systems. NTIA states that relative to existing BPL rules, these recommended new rules would shift emphasis away from elimination of harmful interference from BPL systems to prevention of harmful interference through adaptation of well-proven spectrum management practices. It further submits that the benefits of Access BPL warrant acceptance of a small and manageable degree of interference risk.

20. Some parties representing licensees of services that use frequencies in the 2-80 MHz region of the spectrum, particularly Amateur radio operators, are opposed to allowing the operation of Access BPL.[45] In statements generally reflecting the position of these parties, the National Association for Amateur Radio, also known as the American Radio Relay League (ARRL), submits that while it does not disagree with our efforts to permit additional competition in the offering of broadband services and to bring such services to rural and other underserved areas, it believes that Access BPL in frequency bands between 1.7 MHz and 80 MHz would be a mistake and that we should not authorize its operation without substantial further research.[46] The ARRL argues that it has shown in its comments and reply comments submitted in response to the *Inquiry* that Access BPL has substantial interference potential throughout communities due to the distributive nature of power line radiation of signals in the HF and VHF bands. ARRL further states that the technical study it has filed establishes that there is a significant interference potential from Access BPL systems to the Amateur HF allocations. It also states that there have been at least 27 interference complaints filed to date with the Commission by radio amateurs due to the operation of Access BPL systems at test locations and that some of these have persisted notwithstanding the good faith efforts of some of the Access BPL providers.

21. The ARRL contends that the tentative conclusions in the *Notice* that any interference to licensed radio services will be minimal are unsupported. It states that while the proposed interference mitigation techniques could have some after-the-fact benefit in interference reduction in some instances, they are

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[43], *See* reply comments of SBE at 5.

[44] *See* comments of NAS/CORF at 3.

[45] *See* comments of the Academy of Model Aeronautics (AMA) at 1-3); ARRL at 1-5; Carl Stevenson at 1; CQ Communications, Inc. at 3; the Disaster Emergency Relief Association (DERA) at 1; the Radio Amateur Satellite Corp at 1. In addition, approximately 1500 amateur radio licensees submitted informal comments opposing the proposed rules for the reasons indicated in the ARRL's comments.

[46] *See* comments of ARRL at 2.

inappropriate as a means of authorizing a service that has the potential to interfere with radio services. CQ Communications, Inc. (CQ Communications) believes that the benefits to the public of BPL are overstated, that the damage that will be caused by BPL interference is understated, and that the HF/low VHF region is the wrong spectrum for BPL to utilize. Many individual amateur licensees state that their antennas cannot in most cases be redirected away from power lines because if they were moved, they would not be directed towards desired signals. Many individual amateurs also ask that we define "harmful interference" for purposes of Section 15.5 of the rules. Summarizing the position of the Amateur radio community, the ARRL urges that we not permit Access BPL at this time. It states that if we do proceed with Access BPL rules, we should preclude any use of Amateur radio allocations, or adopt radiated emission rules that are sufficient to predictably protect mobile radio stations from interference, and that we should require Access BPL operators to implement specific interference mitigation measures. The Academy of Model Aeronautics (AMA) submits that BPL operations could interfere with remote control radios in model aircraft that use HF and low VHF frequencies. ARRL also submits that there is no reason to act now on this proceeding, again arguing that we should put this matter on hold (for one year) in order to work out appropriate interference avoidance and resolution standards.

22. The Access BPL system proponents and several electric utility services counter these claims regarding interference potential with arguments that the currently available Access BPL systems have been designed to avoid interference to radio services and that BPL operators have been willing to work in tandem with public safety and other radio service users to prevent or eliminate interference.[47] These parties also point to experience in trials that shows no record of interference.[48] Others, such as PPL Telcom, LLC (PPL Telcom) and Progress Energy, Inc. (Progress Energy) state that they have received some complaints of interference and have resolved them.[49] PPL Telcom further states that in nearly 30 months of Access BPL operation it has received only four complaints of suspected interference, all from Amateur radio operators who were located in close proximity (a few hundred feet or less) from BPL devices. Progress Energy similarly states that in its most recent Access BPL tests no BPL site had any signal levels above S-0 in any Amateur band with a single exception in one subdivision at approximately 25 meters from the extractor and that the level of emissions at that site would cause no interference unless an Amateur were located practically on top of the BPL extractor.[50]

23. We understand the significant concerns of licensed radio service users about the potential for Access BPL services to cause harmful interference to their operations. It is our intention to ensure that Access BPL operations do not become a source of harmful interference to licensed radio services. Based on extensive research, analyses, and practical experience, we also continue to believe that the interference concerns of licensed radio users can be adequately addressed and that Access BPL systems will be able to operate successfully on an unlicensed, non-harmful interference basis under the Part 15 model. In this regard and as discussed below, we find that the harmful interference potential from Access BPL systems operating in compliance with the existing Part 15 emission limits for carrier current systems is low in connection with the additional rules we are adopting. From the information provided

[47] *See e.g.,* Duke Energy at 6; Hawaiian Electric Company, Inc. (HECO) at 5.

[48] See HECO at 3.

[49] *See* comments of PPL Telcom at 6; Progress Energy at 2-3.

[50] Meters or (S)ignal meters have been used by the military on most all of the receivers and discriminators and are being employed into receiver designs of all types today. The (S) meter measures a received voltage across a common load within the transceiver and consists of numbers ranging from S-1 to S-9. Each S unit is equivalent to 6 dB. S-0 is a level that is below the S-1 mark on the meter, thus indicating that the measured level is quieter than what the meter can read.

by our field tests, the tests conducted by NTIA, theoretical predictions by NTIA and ARRL, and experience of the several tests of Access BPL systems, we observe that the potential for any harmful interference is limited to areas within a short distance of the power lines used by this technology. As emphasized by NTIA's Phase 1 study and comments, interference can be rapidly eliminated through various means should it occur. We point out to the individual amateurs commenting in this proceeding that the definition of "harmful interference" as used in Section 15.5 of the rules is set forth in Section 2.1 of the rules.[51] We disagree with ARRL's position that there is no reason to act now in this proceeding and that we should delay our decision on rules for Access BPL to provide more time to develop rules to prevent this technology from causing harmful interference. As indicated above, the broadband service capabilities of Access BPL systems offer important opportunities for establishing a new medium for broadband access and for introducing new competition in the broadband market. We believe that it is important to set forth rules that will promote this service now, rather than delay. In addition, the record provided in response to the *Inquiry* and the *Notice*, including the extensive studies conducted by NTIA, is more than sufficient assure us that the rules we are adopting will adequately protect licensed services from harmful interference. While some cases of harmful interference may be possible from Access BPL emissions at levels up to the Part 15 limits, we agree with NTIA that the benefits of Access BPL service warrant acceptance of a small and manageable degree of interference risk.

24. As stated in the *Notice*, we believe that, on balance, the benefits of Access BPL for bringing broadband services to the public are sufficiently important and significant so as to outweigh the limited potential for increased harmful interference that may arise. Moreover, we continue to believe that cases where interference may occur or where its possible occurrence would impact critical services can be addressed through additional regulatory measures. These additional measures will generally require Access BPL operators to reduce emissions or avoid operation on certain frequencies in order to protect licensed services, to use equipment that can alter its operation by changing operating frequencies to eliminate interference, to make available information that will assist the public in identifying locations where Access BPL operations are present, and to provide notice to radio users before commencing local BPL operations. In this way, the new rules provide effective means for preventing any interference and will ensure that any instances of interference that may occur can be quickly identified and resolved. We emphasize that Access BPL systems will continue be treated as unlicensed Part 15 devices and as such will be subject to the conditions that they not cause harmful interference and that they cease operation if they do cause such interference, as required by our rules.[52] As discussed in paragraph 50, *infra*, except for a few specific frequencies that are reserved for international aeronautical safety operations, we do not believe that excluding BPL operations from frequencies used by any specific service, such as the low VHF TV bands, is necessary or appropriate.[53] Rather, we believe requiring BPL equipment to have the

[51] *See* 47 C.F.R. § 2.1. Section 2.1 defines harmful interference as "[I]nterfrence which endangers the functioning or a radionavigation service or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a radiocommunications operating in accordance with these [international] Radio Regulations. (RR)" We note that this definition is consistent with Resolution 68 of the Radio Regulations.

[52] 47 C.F.R. § 15.5(b).

[53] We do not believe that Access BPL presents a serious threat of interference to broadcast television service on channels 2 to 6. We note that in many instances all low VHF TV channels are not used within a particular area and those not in use for television service could be used for Access BPL operations without causing harmful interference to TV reception. In this regard, we also note that the effective Part 15 limit for Access BPL is more stringent for frequencies above 30 MHz than it is for frequencies below 30 MHz and that propagation losses are also more significant higher in the spectrum. We therefore do not find that special protections for broadcast television service are warranted.

capability to avoid any locally used frequency is the most effective approach to ensuring that harmful interference to licensed operations is avoided.

25. Accordingly, we are amending our Part 15 rules with changes intended to facilitate the deployment of Access BPL technology while protecting licensed users of the spectrum. Specifically, we are: 1) defining Access BPL for purposes of our rules; 2) maintaining the existing Part 15 emission limits for carrier current systems for Access BPL;[54] 3) requiring that Access BPL devices employ adaptive interference mitigation techniques; 4) requiring that Access BPL system operators provide information on the areas where their systems are installed and other technical parameters in a central data base that would be accessible by the public; and 5) adopting specific measurement guidelines for both Access BPL and other carrier current systems to ensure that measurements are made in a consistent manner and provide for repeatable results in determining compliance with our rules. These actions are discussed more fully below.

A. Definition of Access BPL

26. In the *Notice*, we proposed to define Access BPL for purposes of the Part 15 rules as a carrier current system operating on any electric power transmission lines owned, operated, or controlled by an electric power provider, as follows:

> *Access broadband over power line (Access BPL).* A carrier current system that transmits radio frequency energy by conduction over electric power lines owned, operated, or controlled by an electric service provider. The electric power lines may be aerial (overhead) or underground.[55]

We also requested comment on whether there are entities that plan to own/operate Access BPL over electric power lines but would not be electric power providers or a subsidiary of the incumbent electric power provider.[56]

27. Echelon Corporation (Echelon), the IEEE Power System Relaying Committee (IEEE/PSRC) and several others suggest that the proposed definition of Access BPL be modified to specifically apply to systems with operating frequencies above 1.705 MHz, or at least above 1 MHz.[57] These parties specifically request that the older power line carrier systems used by electric utilities, as defined in the existing rules, not be included within the definition of Access BPL.[58] The United Power Line Council (UPLC) recommends that we clarify that power lines as termed in the definition of Access BPL exclude lines within customer premises or in riser conduit within buildings, because these power lines are not owned or controlled by the electric utility.[59] Duke Energy Corporation (Duke Energy) submits that the definition should not incorporate BPL equipment used by a utility within its own building for the purpose

[54] We are, however, exempting Access BPL from the conducted emission limits contained in § 15.107(c).

[55] *Notice* at ¶32.

[56] *Id.*

[57] *See* comments of Echelon Corporation at 4; IEEE Power System Relaying Committee at 2; PPL Telcom at 4; Progress Energy at 2; Southern at 13; UPLC at 4.

[58] 47 C.F.R. §15.113 permits power line carrier systems to operate on power transmission lines using frequencies in the 9-490 kHz band for communications important to the reliability and security of electric service to the public. *See also* 47 C.F.R. §2.106, note US294.

[59] *See* comments of UPLC at 5.

of internal networking.[60] NTIA and Southern state that we should also adopt a definition for In-House BPL to properly frame the applicable rules and measurement procedures for BPL operation.[61] Main.Net Communications Ltd. (Main.Net) comments that business models are being developed where the owner/operator of the Access BPL system will not be the electric power provider or its subsidiary ("landlord" model).[62]

28. We are adopting a modified version of the proposed definition of Access BPL that includes changes as suggested by the commenting parties. In this regard, we agree that the definition of Access BPL should not include the low-speed power line carrier systems used by electric utilities as defined in our rules. Transmissions on these systems have very short duty cycles that pose very low interference potential as opposed to the constant operation that characterizes Access BPL. We also agree that the definition for Access BPL should limit the low frequency cut-off to above 1.705 MHz, which is the upper frequency for the AM broadcast band. We agree that the definition for Access BPL should not include power lines located within a customer's premises or within a utility's own premises. These lines generally carry low voltage power, are not under the ownership or integral control of the power service operator, are isolated from the medium voltage lines by a distribution transformer such that a bypass device must be used to reach them with BPL signals, and pose lower potential as sources of interference because their emissions are attenuated by the structure in which they are located. We also see no need to limit ownership or control of BPL operations to electric utility operators. We believe that an independent BPL provider can take the same steps and precautions as an electric utility operator in working with its equipment vendor, the power system, and licensed radio users to ensure that an Access BPL system does not cause harmful interference and to resolve any interference. We also see no need to specifically mention aerial or underground lines in the definition. Furthermore, we note that the record in this proceeding only addresses Access BPL systems operating over medium voltage and low voltage lines. Because the high voltage lines are located physically higher, can carry very high voltages, and have different configurations as well as characteristics with respect to potential harmful interference, we are excluding them from the definition for Access BPL at this time. Access BPL systems intended for high voltage lines can however operate under the requirements for experimental licensing in Part 5 of the Commission Rules.[63]

29. We therefore are amending Section 15.3 of the rules to include the following definition for Access BPL:

> *Access Broadband Over Power Line (Access BPL).* A carrier current system installed and operated on an electric utility service as an unintentional radiator that sends radio frequency energy on frequencies between 1.705 MHz and 80 MHz over medium voltage lines or low voltage lines to provide broadband communications and is located on the supply side of the utility service's points of interconnection with customer premises. Access BPL does not include power line carrier systems as defined in Section 15.3(t) of this part or In-House BPL systems as defined in Section 15.3(gg) of this part.

30. While we are not generally addressing rules for In-House BPL systems, except for measurement procedures, we do find it useful and appropriate to set forth a definition of such systems in the rules

[60] *See* comments of Duke Energy at 4.

[61] NTIA at 3-4, Southern at 14.

[62] *See* comments of Main.Net at 5.

[63] *See* 47 C.F.R § 5.

herein. As NTIA and Southern point out, specifying a definition of In-House BPL systems will fully define all forms of BPL and help to clarify the differences between Access BPL and In-House systems. We find that the definition of In-House BPL suggested by NTIA properly identifies these systems. Accordingly, we are adopting the following definition for In-House BPL:

> *In-House Broadband Over Power line (In-House BPL).* A carrier current system, operating as an unintentional radiator, that sends radio frequency energy to provide broadband communications on frequencies between 1.705 MHz and 80 MHz over low-voltage electric power lines that are not owned, operated or controlled by an electric service provider. The electric power lines may be aerial (overhead), underground, or inside walls, floors or ceilings of user premises. In-House BPL devices may establish closed networks within a user's premises or provide connections to Access BPL (as defined in Section 15.3(ff) of this part) networks, or both.

We also encourage industry efforts to develop standards for In-House BPL systems and devices that are complementary to and compatible with Access BPL operations.

31. *Access BPL Systems Above 80 MHz.* Corridor Systems (Corridor) asserts that it has developed an Access BPL technology that operates at 5.8 GHz and states that the proposed measurement guidelines of the *Notice* are not appropriate for the microwave frequency region where wavelengths are measured in small numbers of centimeters rather than meters or tens of meters. Corridor contends that its Access BPL technology is categorically different from the HF BPL systems from other vendors and that the definition as well as the test methods as proposed in the *Notice* would impose an inappropriate regulatory burden on its systems.[64] Satius, Inc. states that its Access BPL technology operates in several different bands from 2 MHz to several GHz.

32. We agree with Corridor that Access BPL systems operating in higher regions of the spectrum, such as the Corridor Access BPL system at 5.8 GHz, should not be subject to the rules adopted herein for Access BPL systems operating in the HF and low VHF spectrum. We find that the record in this proceeding does not provide sufficient information regarding Access BPL operating in spectrum above 80 MHz, hence a decision regarding this type of Access BPL technology cannot be effectively rendered at the present time; however, Access BPL systems not covered in the above definition are subject to existing applicable Part 15 rules for carrier current systems. However, we will monitor the development of Access BPL systems that operate on frequencies above 80 MHz and may consider additional requirements for Access BPL systems operating above 80 MHz in a future rulemaking if appropriate.

B. Emission Limits

33. *General Emission Limits.* Consistent with our stated intention to proceed cautiously in authorizing BPL systems, we proposed in the *Notice* to continue to apply the existing radiated emission limits for carrier current systems used as unintentional radiators, as set forth in Section 15.109(e) of the rules, to Access BPL systems.[65] While we recognized that there is some potential for Access BPL operations to cause interference, we tentatively concluded that the likelihood of harmful interference would be low under the current radiated emission limits as well as other provisions adopted herein, and that where such interference does occur, there are remedies that the Access BPL operator can employ to eliminate it. We also proposed to exempt Access BPL systems from the conducted emissions limits in

[64] Comments of Corridor at 2-4.

[65] *See* 47 C.F.R. § 15.109(e).

15.107(c) of the rules.[66] In this regard, we observed that because Access BPL systems are generally installed on power lines that carry 1,000 to 40,000 volts, measuring the conducted emissions of these systems is very difficult and can also present safety hazards.[67] We stated that since Access BPL systems would still be required to comply with our radiated emission limits, we did not believe that this exemption would have any impact on BPL interference potential.[68] Finally, we requested comment on whether any additional measures are needed to protect particular operations, such as public safety agencies that use the HF bands for state-wide public safety communications.

34. *a) Emission Limits.* NTIA concurs with our proposal to continue to subject Access BPL systems to the existing radiated emission limits for carrier current systems and submits that interference risks can and should be suitably reduced through refinement of the compliance measurement provisions.[69] NTIA states that the current perceived risks of interference from BPL operations preclude relaxing the limits.[70]

35. A number of parties generally representing the interests of entities favoring the introduction of BPL services support our proposals for emission limits on BPL operations. These parties, who include AT&T, Duke Energy, Main.NET, NTIA, PPL Telcom, Satius, Southern, and UPLC, generally agree that the existing Part 15 radiated emission limits are sufficient to limit the potential for interference.[71] Southern states that the proposed limits are an acceptable compromise between the interests of those who believe that stricter limits are needed and the position of BPL manufacturers and providers who state that their systems do not cause harmful interference under the current limits. Duke Energy, PPL Telcom, Southern, and UPLC also submit that the Commission should revisit the emission limits at a later date after more information is developed on the interference potential of BPL operation to possibly relax the limits.[72] Main.Net requests that we consider higher radiated emission limits in situations such as rural areas, where it argues an increase in emissions would not cause interference.

36. Others, including the AMA, the ARRL, Bob Lombardi, Carl Stevenson, and the IEEE USA, who represent the interests of licensed spectrum users, argue that the current emission limits are too high to protect nearby Amateur radio stations against interference.[73] These parties generally submit that the

[66] See 47 C.F.R. § 15.107(c). For the protection of the AM Broadcast service, existing carrier current systems operating below 30 MHz are subject to a conducted emission limit of 1000 μV in the AM broadcast band (from 535 to 1705 kHz). *See* 47 C.F.R. §§ 15.107(c)(2) and 15.221. However, carrier current systems operating above 30 MHz are subject to the general conducted emission limits that apply to frequencies below 30 MHz. *See* 47 C.F.R. § 15.107(a)-(c).

[67] Conducted emissions are measured by connecting the Equipment under Test (EUT) to a Line Impedance Stabilization Network (LISN) that simulates the impedance of the power network while sourcing power to the EUT. Such a LISN would have to be capable of sourcing 1,000 volts to 40,000 volts to an Access BPL system. Furthermore, measuring instruments such as spectrum analyzers, voltmeters, etc. would also be connected to this LISN, thus high voltage hazards could affect both test equipment and test personnel.

[68] *Notice* at ¶38.

[69] *See* comments of NTIA at 7.

[70] *See* comments of NTIA at 7.

[71] *See* comments of AT&T at 4; Duke Energy at 13; Main.NET at 5-6; NTIA at 7; PPL Telcom at 4; Satius at 4; Southern at 15; and UPLC at 7.

[72] *See* comments of Duke Energy at 13; PPL Telcom at 4; Southern at 16; UPLC at 7.

[73] *See* comments of the AMA at 4; the ARRL at 9-10; Bob Lombardi at 7; Carl Stevenson at 8; and the IEEE USA at 10.

current limits were never designed for distributive radiating systems but rather were designed to address the interference potential of point source radiators. In statements representative of these parties, the ARRL contends that the limits should be reexamined for the context where the system architecture is a line source radiator that creates a situation in which the unshielded power lines act as efficient radiators throughout neighborhoods. It states that based on information from the NTIA Phase 1 Study and several additional studies, copies of which it attached to its comments, Access BPL, operated at the current Section 15.109 and Section 15.209 field strengths, will create substantial interference to nearby Amateur radio stations, whether fixed or mobile.[74] The ARRL argues that lower permissible field strengths are necessary to protect mobile radio stations.[75] It suggests that an acceptable radiated emission limit for Access BPL to protect typical amateur mobile stations is 0 dBμV/m, measured at an antenna 10 meters from the power line.[76] In its reply comments, the ARRL argues that NTIA's findings establish that fixed Amateur stations can expect to receive interference at distances of 460 meters from a BPL device, even assuming that the device meets the radiated emission limits of existing Part 15 regulations and that mobile stations would be subject to interference at distances up to 75 meters from a BPL device on the power line.[77] Echelon further recommends requiring Access BPL systems to employ band-pass filters that offer at least 80 dB attenuation of emissions below 535 kHz and that Access BPL band-pass filter wiring be designed to separate low-voltage and medium-voltage mains wiring by at least 18 inches to prevent cross-mains inductive signal coupling.[78] On the other hand, PPL Telcom states that Access BPL operations will not operate as line source radiators because 1) equipment within the same network operates at different frequencies, thereby reducing the potential cumulative effect at any given frequency; 2) equipment is deployed in different orientations on power lines so that the polarization of emissions will vary; and 3) equipment operating on the same frequency will have differing phase displacements.[79]

37. LecStar Telecom, Inc. and LecStar DataNet, Inc. (collectively "LecStar") recommends that we treat Access BPL systems as Class A devices in order to allow these systems to take advantage of the higher Class A emission limits.[80] LecStar submits that treatment of Access BPL systems as Class A equipment would allow equipment costs to be lower and thereby speed the deployment of systems and improve their economic viability. Satius, Inc. submits that it has developed Access BPL equipment that

[74] The ARRL argues that, based on information in the NTIA Phase 1 Study, at the current Part 15 limits, the interference contour of Access BPL systems to land vehicle, boat, and fixed stations receiving moderate to strong desired signals in the frequency range 1.7-80 MHz is likely in areas extending to 30 meters, 55 meters, and 230 meters, respectively. ARRL further contends that interference to aircraft reception of moderate to strong desired signals is likely to occur at heights up to 6 km altitude within 12 km of the center of the BPL deployment. The three additional technical studies ARRL appends to its comments are: 1) Exhibit A- "BPL Trial Systems Electromagnetic Emission Tests," by Metavox, Inc., of Dulles, Virginia ("Trial System Tests"); 2) Exhibit B- "Interference Assessment of PLC Compatibility with Allocated HF Systems," by Dr. David Cohen of the University of Maryland ("Interference Assessment"); and 3) Exhibit C- "Proposed Radiated Emission Limits and Extrapolation," by ARRL Chief Technology Officer Paul Rinaldo (ARRL Study).

[75] *See* comments of ARRL at 25-26 and Exhibit E.

[76] Comments of ARRL at 26.

[77] *See* reply comments of ARRL at 10.

[78] *See* comments of Echelon at 5.

[79] *See* comments of PPL Telcom at 5.

[80] *See* comments of LecStar Telecom, Inc. and LecStar DataNet, Inc. (collectively "LecStar") at 4-5.

can reduce emissions by more than 40 dB in certain bands where interference would otherwise occur.[81] It requests that we provide an exception to the emission limits that would allow devices that are capable of reducing emissions by at least 40 dB for interference control to operate with emissions in other bands that are 10 dB higher than the Class A limits.

38. We continue to believe that it is appropriate to apply the existing Part 15 radiated emission limits to Access BPL systems. We are not persuaded by the arguments of ARRL and others representing licensed spectrum users that the current emission limits are insufficient to limit the general interference potential of these systems. The 0 dBμV/m limit suggested by the ARRL is typically below the noise floor in the HF and low VHF bands and would be unnecessarily and prohibitively restrictive for Access BPL operators.[82] Along with NTIA, we conclude that the current emission limits will restrict Access BPL systems to very low emitted power levels in comparison to the signals of licensed radio operations. The effect of these limits will be to constrain the harmful interference potential of these systems to relatively short distances from the power lines that they occupy. In fact, in most cases the level of emissions from Access BPL systems will be at or close to the noise floor at distances beyond a hundred meters of an installed power line. We recognize that some radio operations in the bands being used for Access BPL, such as those of Amateur radio licensees, may occur at distances sufficiently close to power lines as to make harmful interference a possibility. We believe that those situations can be addressed through interference avoidance techniques by the Access BPL provider such as frequency band selection, notching, or judicious device placement; the rules we are specifying herein facilitate such solutions. We do not see evidence that BPL operation will significantly contribute RF energy to generally raise the background noise level.[83] In addition, because power lines inherently can radiate significant noise emissions as noted by NTIA and ARRL, good engineering practice is to locate sensitive receiver antennas as far as practicable from power lines. This practice will also help prevent interference from Access BPL emissions. In fact, as stated by NTIA, power line noise emissions at frequencies up to 800 MHz may actually be reduced as Access BPL systems are deployed. Furthermore, we see no need to impose a strict band-pass filtering on Access BPL, and we deny Echelon's request in this regard.

39. Although we agree with ARRL that Access BPL on overhead lines is not a traditional point-source emitter, we do not believe that Access BPL devices will cause the power lines to act as countless miles of transmission lines all radiating RF energy along their full length. First, the Part 15 emission limits for carrier current systems have proven very effective at controlling interference from such systems. Also, for the reasons indicated by PPL Telcom, we believe that the design and configuration of Access BPL systems will be inconsistent with the development of cumulative emissions effects for nearby receivers.[84] Moreover, the NTIA Phase 1 Study and our own field measurements of Access BPL installations indicate that these systems are not efficient radiators, nor are their emissions cumulative such that they permeate areas in which they are located.[85] Rather, we find that emissions from Access

[81] *See* comments of Satius, Inc. at 4.

[82] Comments of ARRL at 26.

[83] We would also advise ARRL that in cases where its members experience reception of RF noise, such noise can often be avoided by carefully locating their antennas; in many instances an antenna relocation of only a relatively short distance can resolve noise interference (*see* ARRL comments at 13).

[84] As we observed in the *Notice*, Current Technologies, Main.Net and other Access BPL equipment manufacturers similarly state that in their Access BPL equipment implementations only a limited number of devices transmit simultaneously on the same frequency in the same geographic area, *see Notice* at 16, recognizing the reply comments of Current Technologies at 11; Main.Net at 3; Ameren at 13.

[85] *See* NTIA Phase 1 Study, Volume 1, at 5-5 to 5-15.

BPL systems tend to dissipate after a short distance from a coupler along a line, and then remain relatively the same for some distance. Along the line there also may be multiple points where emissions may be relatively higher but within the Part 15 limits.[86] However, because the signal level decreases significantly with distance perpendicular from the line, the potential for interference also decays rapidly with distance from the line. To ensure that the effects of the power line as a radiator are taken into consideration when testing for compliance with our Part 15 rules, the measurement procedures we are adopting for Access BPL systems, as discussed *infra*, and set forth in Appendix C, specify that emission measurements are to be made at several specific distances from the Access BPL equipment source, and that measurements are to be taken parallel to the power line to find the maximum emissions from the BPL system.

40. The technical studies submitted by ARRL as appendices to its comments do not provide any information which would lead us to alter our assessment that the current emission limits are appropriate. The first ARRL study, "Trial System Tests," merely reports the results of measurements of an Access BPL trial system, with findings that in some instances that system appears not to have complied with the emission limits. The second ARRL study, "Interference Assessment," argues that the more stringent German RegTP standard NB 30 emission level is sufficient to protect radio services. We find that this stringent emission limit is not necessary to protect against interference and that it would unjustifiably constrain the operation and manufacture of Access BPL systems. It is our understanding that the German standard has enabled deployment of Access BPL systems on underground power lines but we have no information indicating that such a standard could generally be met on overhead power lines that constitute much of America's power distribution system. We believe the approach that we are adopting is a more appropriate policy for balancing the concerns at issue in this matter. Finally, the third study, "ARRL Study" argues that overhead power lines are efficient line radiators and offers suggestions for measurement of emissions; it does not address the sufficiency of our emissions limits. We are requiring compliance with the protective Part 15 field strength limits regardless of whether the field strength is efficiently generated. For the reasons indicated above, we continue to believe that the existing Part 15 emission limits for carrier current systems, in conjunction with certain additional measures as discussed below, are adequate and appropriate to protect licensed radio operations from Access BPL operations. We disagree with Main.Net that there are situations where there is generally less likelihood that Access BPL systems operating at emission levels above the current limits would cause interference. Licensed services operate in rural as well as more densely populated areas. Accordingly, we will continue to apply the current Part 15 radiated emission limits to Access BPL operations. While we do not believe that there will be reason to revisit this decision in the near future to possibly consider allowing Access BPL systems to operate at higher emission levels, we would do so if information develops that raising the limits might be possible without incurring unacceptable risk of interference.

41. Notwithstanding our decision on emission limits, we do recognize that Access BPL systems present concerns for licensed users in the HF and low VHF bands, given the propagation characteristics of RF signals in the range of frequencies being used for these systems, the diversity of users of these frequencies, and the fact that Access BPL devices will be installed at many locations in an area. While we conclude, as discussed above, that the likelihood that interference from Access BPL operations will occur is low at the signal levels allowed under the current Part 15 emission limits, such interference could occur in limited situations despite the intentions of BPL operators. Moreover, even if interference were to occur to amateur operations at the distances indicated by the ARRL, as recommended by NTIA, there are additional interference mitigation techniques that we are requiring of BPL providers to address such interference potential. We believe that such steps should be taken, particularly in those cases where

[86] The points of relatively higher emissions tend to occur at junctions and other points on a line where there are impedance mismatches.

the occurrence of interference would affect critical services or where interference could be anticipated to occur. We will address such additional measures to mitigate and/or eliminate interference in the next section.

42. Most of the commenting parties that addressed the issue of conducted emission limits support our proposal to exempt Access BPL from compliance with such limits.[87] The IEEE/PSRC submits that requiring conducted emission tests on medium voltage power lines is a safety hazard to both test personnel and equipment and should be avoided.[88] For the reasons of safety and the fact that Access BPL systems will be required to comply with our radiated emission limits, we will not subject these systems to conducted emission limits. Dale G. Svetanoff and Cortland E. Richmond nonetheless believe that conducted emissions limits should still be applied to Access BPL systems in the laboratory before equipment is shipped and installed, in order to detect variations in equipment.[89] We find no need to subject Access BPL equipment to a conducted emission limit that would apply for compliance measurement purposes before the equipment is shipped and installed. We note that Access BPL manufacturers already test their equipment for the proper power levels in a laboratory as part of their manufacturing procedures, and in any case, as discussed below, the radiated emissions from a representative model of equipment would be measured *in-situ* at three sites as part of the equipment authorization process. We therefore find that requiring conducted emission tests in the laboratory would be a redundant and unnecessary procedure.

43. With regard to LecStar's request that we treat Access BPL systems as Class A devices in order to allow these systems to take advantage of the higher Class A emission limits, we note, as indicated above, that the medium voltage portions of such systems are already treated as Class A devices under our rules. The Class A limits are appropriate in this case because Access BPL devices are not marketed to the general public and operate on the medium voltage power lines as commercial facilities. Those portions of Access BPL systems that operate above 30 MHz on the low-voltage power lines from the distribution transformer to a residence and all in-house wiring connected to a BPL device are subject to Class B radiated emission limits. The Class B limits are appropriate for these operations because they are located within residential environments and are marketed for use by the general public. Although Access BPL systems are required to comply with the less stringent Class A limits, operators will nonetheless have a strong incentive to exercise the utmost caution in installing and operating their systems to avoid harmful interference and ensure uninterrupted service to their customers, given that there is significant investment in the deployment of the service. We do not find that a 10 dB increase in the allowable emissions levels is warranted or desirable for systems that can reduce emissions by 40 dB in selected bands, as suggested by Satius. We believe that it is important that Access BPL systems comply with the emission limits across their entire operating range in order to minimize the potential for interference in all bands, not just those where interference may be more likely at a particular location. Accordingly, we are denying Satius' request for such an exception.

44. *b) Other Protection Measures.* NTIA states in its comments that additional emission restrictions are needed in certain frequency bands and geographic areas in order to protect Federal Government and certain other radio operations. It states that these restrictions would have the form of geographic "coordination areas" wherein BPL deployments at any frequency in those areas must be "pre-coordinated" by BPL operators; excluded bands in which certain frequencies are not to be used by BPL in any geographic area; and small geographic "exclusion zones" wherein BPL emissions are forbidden at

[87] *See* comments of Progress Energy at 5; Southern at 17; Main.Net at 6; PowerWAN at 2.

[88] *See* comments of IEEE/PSRC at 3.

[89] *See e.g.,* comments of Dale G. Svetanoff at 3; Cortland E. Richmond at 13.

specified frequencies in accordance with protection requirements and electromagnetic compatibility studies. Under NTIA's plan, these coordination areas, excluded bands, and exclusion zones would be defined in the rules for Access BPL systems. NTIA submits that to protect Federal Government radio users, it plans to voluntarily provide BPL operators with site location and frequency band information to Access BPL users that would facilitate steps to prevent interference to these users. It states that these measures would virtually eliminate certain interference risks for even the most sensitive and vulnerable Federal Government and other radio services. NTIA has separately provided lists of the coordination areas and radio users therein that would be specially considered, the excluded bands, and the geographic exclusion zones that would be subject to these additional protections.[90]

45. NTIA further recommends that we require Access BPL operators to consider frequency avoidance capabilities in conjunction with voluntary, *a priori* consultation regarding potentially affected receiving stations at known locations or service areas. It states that Access BPL operators would receive radio frequency usage data from concerned radio service licensees by e-mail and then use frequency avoidance capabilities (as discussed below) to preclude Access BPL operation on locally used frequencies where necessary. In contrast, within consultation areas and at the associated frequencies, the radio and BPL operators would mutually determine whether BPL deployment or operating constraints are needed. To make information available to local radio users, NTIA proposes that Access BPL operators be required to notify planned deployments to the Access BPL data base administrator (as discussed below) at least 30 days in advance of system implementation.[91] It further suggests that Access BPL operators can extract local frequency assignment data from our data bases, identify the locations and frequencies used by local radio receivers, and plan their operational frequencies in a manner that avoids BPL interference to local radio receivers.[92]

46. NAC/Amherst suggests that we establish "BPL-free" zones in which Access BPL would not be permitted within 20 miles of airports and antennas for ground-to-air communications and military bases, and within two miles of hospitals, police stations, and fire stations.[93] ARINC urges the Commission to refrain from authorizing Access BPL to operate in the Aeronautical Mobile [R] frequency bands.[94] In response to NTIA's comments on excluded bands and exclusion zones, ARRL also strongly urges that all Amateur HF and VHF allocations be included with other bands that NTIA determines require protection from BPL interference.[95]

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[90] The coordination areas, excluded bands, and geographic exclusion zones identified by NTIA are set forth in the new rules in Appendix B. When considered together, the excluded frequency bands listed in Section 15.615(f)(1), Table 1 in Appendix B are limited to those allocated to aeronautical mobile [R] and radionavigation services that are used to provide aeronautical safety of life services. The exclusion zones are limited to a radius of 1 km around coast station facilities located at the 106 coordinates listed in Section 15.615(f)(2)(i), Table 2 in Appendix B, and within a radius 29 km (for Access BPL using overhead medium voltage power lines) or 11 km (for other Access BPL implementations) of the coordinates for the ten Very Long Baseline Array facilities listed in allocation US311. To avoid confusion with "coordination" requirements specified elsewhere in the Commission's rules, we are adopting the term "consultation area" rather than "coordination area" in connection with the Access BPL rules. The frequency bands and areas for consultation are listed in Section 15.615(f)(3), Tables 3-6 of Appendix B.

[91] *See* comments of NTIA at 11.

[92] *See* comments of NTIA at 11.

[93] *See* reply comments of NAC/Amherst at 6.

[94] *See* reply comments of ARINC, Section IV.

[95] See reply comments of ARRL at 17-18.

47. Ameren, PLCA, and Southern recognize the benefits of NTIA's offer to make available to BPL operators information on Federal Government frequency assignments to assist in Access BPL frequency selection, but it opposes mandatory prior frequency coordination.[96] Southern argues that the mandatory prior coordination would effectively subject BPL to the same conditions as a licensed service without the benefits of licensing.[97] Ameren Energy Communications, Inc. (Ameren) and the Power Line Communications Association (PLCA) argue that a requirement for Access BPL operators to prior coordinate is not borne by other broadband service providers with equipment similarly subject to Part 15 of the Commission's rules.[98] The PLCA adds that, more undesirably, there would be no licensing process or procedure in place to determine whether a contested installation may proceed. Current and Duke Energy is concerned that NTIA's excluded bands and exclusion zone proposals could result in limitations on the deployment of Access BPL systems such that there would be gaps in coverage to the point where it would no longer make economic or operational sense to deploy.[99] Current contends that while there may be a few instances, such as locations very close to co-frequency radio astronomy receive sites, where coordination would be appropriate, the levels of BPL emissions should make such instances extremely uncommon.[100]

48. APCO/NPSTC, APCO Region 21, the International Municipal Signal Association (IMSA), and the Missouri State Highway Patrol (MSHP) submit that there are public safety systems in the HF (2-7 MHz), low VHF (30-50 MHz), and VHF (72-76 MHz) bands that must be protected from interference.[101] APCO/NPSTC states that considering the rural nature of public safety operations in the low VHF bands, the only way a public safety officer will know that interference is present in a given location is when the officer cannot communicate in an area. APCO Region 21 states, for example, that Access BPL could raise noise levels and overwhelm receiver circuits.[102] The MSHP submits that because Access BPL is a distributed technology, it will be difficult to isolate interference locations. The MSHP therefore recommends that Access BPL be required to take steps to avoid interference with public safety operations before deployment, rather than wait for a public safety agency to find out about harmful interference by being unable to communicate with an originating distress call.[103] It argues that Access BPL systems should be required to prove *a priori* that they are not causing interference, rather than waiting until a public safety agency finds out that harmful interference is present in an area where a distress call originates. APCO/NPSTC also submits that it does not want to be in the position of

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[96] *See* reply comments of Southern at 28.

[97] *See* reply comments of Southern at 35.

[98] *See* reply comments of Ameren at 12 and PLCA at 4.

[99] *See* reply comments of Current at 30 and reply comments of Duke Energy at 19.

[100] Reply comments of Current at 30.

[101] *See* comments of APCO/NPSTC at 2; APCO Region 21 at 4. The High Frequency (HF) band covers frequencies from 3 to 30 MHz. The Very High Frequency (VHF) band covers frequencies from 30 to 300 MHz. APCO indicates that the HF band (2-7 MHz) is used by state emergency management agencies to coordinate disaster relief and that the low VHF (30-50 MHz) band is used by many first responder agencies (emergency medical systems (EMS), fire, and law enforcement) as well as public safety support agencies. APCO further indicates that the 30-50 MHz band is used significantly by thirteen states for state police operations, with nine states, including California, using it as their primary communications band.

[102] *See* comments of APCO Region 21 at 4.

[103] *See* comments of the MSHP at 3.

demanding that Access BPL operators cease operating due to harmful interference to public safety radio after the operators have made large investments in BPL infrastructure.

49. We agree with NTIA and the parties representing public safety agencies that critical Federal Government and other services specified by NTIA and public safety warrant additional protection. These services, including national defense, maritime distress and safety, aeronautical navigation and communications, emergency response, radioastronomy, and others provide important safety and research services whose functions would be afforded additional protection against possible interference from Access BPL operations. We agree with and are adopting NTIA's approach for addressing additional protection to critical Federal Government and other radio operations. The excluded frequency bands amount only to a total of 1731 kHz, or 2% of the spectrum within the 1.7-80 MHz band. The exclusion zones are relatively few, on only the 2173.5 to 2190.5 kHz global maritime distress signaling band with prohibited distances of 1 km from coast station facilities, and 73.0 – 74.6 MHz band used by the ten Very Long Baseline Array facilities of radio astronomy observatories with prohibited distances of 29 km and 11 km for Access BPL systems using overhead medium voltage power lines and other Access BPL implementations, respectively.[104] We agree with NTIA that the potential for interference from Access BPL to the critical services in exclusion zones is somewhat greater for transmissions carried on overhead medium voltage lines than other Access BPL implementations, *i.e.* transmissions carried on underground lines or low voltage lines. In this regard, emissions from underground power lines are generally attenuated by the earth materials in which they are buried, while emissions from low voltage lines are generally lower because such lines are generally used only for short feeder links from a transformer to a customer service location and these lines are more closely spaced with an accompanying neutral line--and in fact are often twisted together with the neutral line. The close spacing--together with the shorter length--reduces radiated RF emissions relative to those from overhead medium voltage lines. In addition, the requirement to contact and work with the Federal Government in the 53 consultation areas is not generally expected to result in major impact on Access BPL operators' flexibility to use specific frequency bands.[105] We therefore find that avoiding operation on the frequencies excluded under these restrictions and requirements will not be burdensome for Access BPL operators and manufacturers in order to protect distress and safety communications. Indeed, several manufacturers and Access BPL operators have indicated that they are capable of, and already do, notch out certain frequency bands.[106] We disagree with Ameren, PLCA, and Southern that the mandatory consultation provisions imposed on Access BPL operators impose burdens on Access BPL operators not borne by other unlicensed broadband operators without countervailing benefits. For example, in Part 76, we require that cable operators conduct measurements annually to ensure that signal leakage does not create interference risks. Moreover, the distributive nature and other technical characteristics of Access BPL pose somewhat higher potential for interference than point-source wireless broadband systems that warrant additional protective measures. In addition, the consultation actions will benefit Access BPL operators by leading them to select frequencies at the beginning of their service so as to avoid interference to critical services that might have to be corrected later. Accordingly, we are adopting NTIA's list of consultation areas, excluded bands, and exclusion zones to which Access BPL equipment must adhere. For all other radio communication operations not addressed in these special provisions, radio operators have the opportunity

[104] *See* Section 15.615(f)(1), Table 1 and Section 15.615(f)(2)(i), Tables 2 and 2.1 in Appendix B

[105] We note that the operations in these coordination areas generally include Federal Government users in the 1.7-80 MHz spectrum that provide safety services (e.g. the Federal Emergency Management Agency (FEMA), the Department of Homeland Security (DHS), etc.).

[106] *See, e.g.,* comments of PowerWAN at 1, indicating that it already notched amateur bands in its BPL system.

to inform local BPL operators of the pertinent details of their operations and BPL operators have the opportunity to apply that information as appropriate to prevent interference.

50. With regard to the consultation areas, we will require Access BPL operators to provide notification to the parties listed as Federal Government contact points, as designated in the rules set forth in Appendix B, for the area in which their systems will operate at least 30 days prior to initiation of service. The notification shall include: 1) the name of the Access BPL provider, 2) the frequencies of the Access BPL operation, 3) the postal zip codes served by the Access BPL operation, 4) the manufacturer of and type of Access BPL equipment being deployed (*i.e.*, FCC ID), 5) point of contact information (both telephone and e-mail address), and 6) the proposed or actual date of initiation of Access BPL operation. We will also require that systems located in consultation areas that were in operation prior to the effective date of these rules provide this notice to the appropriate contact point within 45 days of that date. NTIA has indicated that it plans to arrange to have information made available to BPL operators on Federal Government operations. We expect parties to consult in good faith to ensure that no harmful interference is caused to licensed operations and that any constraints on BPL deployments are minimized to those necessary to avoid harmful interference.

51. As indicated in the *Notice*, we believe that the risk of harmful interference to state and local public safety services, *i.e.*, EMS, fire, law enforcement, and emergency management agencies from Access BPL operations is essentially low.[107] In general, we believe that a properly designed and operated Access BPL system will pose little interference hazard to services such as aeronautical, maritime and public safety that are designed to operate with relatively high signal-to-noise ratios. In analyzing the potential for harmful interference to public safety systems, we took into account the fact that low-level Part 15 signals from Access BPL devices attenuate rapidly as the distance from the power line increases; and that most public safety systems are designed so that mobile and portable units receive a signal level significantly above the noise floor. From an interference analysis standpoint, this latter characteristic distinguishes public safety systems from amateur radio stations using high-sensitivity receivers to receive signals from transmitters often thousands of miles away. However, it is foreseeable that under certain rare circumstances a public safety unit could: a) operate in close proximity to a power line carrying Access BPL transmissions at a location where field strength is near the Part 15 limit; b) be tuned to a frequency radiated by an Access BPL device; and c) be receiving a weak signal from a distant, or obstructed, public safety base station. In general, potential harmful interference under these conditions would be limited to public safety units operating on systems using low-band VHF channels (25-50 MHz).[108] We therefore conclude that the interference protections set forth above will be adequate to foreclose harmful interference to public safety systems except perhaps under such unusual circumstances.

52. However, we also conclude that public safety systems merit additional protection because of the often critical and/or safety-of-life nature of the communications they provide. Given the importance and nature of public safety communications, we believe it is necessary to require Access BPL systems to notify the public safety agencies in their local areas, *i.e.*, state and local police, fire, emergency medical, any special emergency coordinators, call box operators, and other entities that are eligible for public safety licenses under Section 90.20 of the rules.[109] This advance notification will provide public safety

[107] *See Notice* at ¶37.

[108] The Commission's records reflect that there are approximately 18,237 Public Safety licenses (Radio Service Code - PW) for systems operating between 25-50 MHz. The historical trend in public safety systems is use of higher frequency bands. Although we are not imposing operating frequency limitations on Access BPL devices, we note that the equipment available to date operates on frequencies below 50 MHz.

[109] *See* 47.C.F.R. § 90.20.

operators with an opportunity to assess whether there are portions of its geographic area of responsibility about which it should make special arrangements with the Access BPL operator in order to avoid interference. Consistent with our decision on notifications for Federal Government consultation areas above, we will require that this notification be provided to local public safety agencies at least 30 days prior to a system's initial operation, the activation of any major extensions of the system, or any changes in its operating characteristics, *i.e.*, transmitting frequencies. The notification shall include: 1) the name of the Access BPL provider, 2) the frequencies of the Access BPL operation, 3) the postal zip codes served by the Access BPL operation, 4) the manufacturer of and type of Access BPL equipment being deployed (*i.e.*, FCC ID), 5) point of contact information (both telephone and e-mail address), and 6) the proposed or actual date of initiation of Access BPL operation. We will also require that systems in operation prior to the effective date of these rules provide this notice to local public safety agencies within 45 days of that date.

53. We do not see a need to establish Access BPL-free zones around airports, military bases, hospitals, police stations and fire stations, as requested by NAC/Amherst. To the extent that these services warrant special protection, they will be afforded protection through the excluded bands, exclusion zones and consultation areas specified by NTIA. We similarly do not find that amateur radio frequencies warrant the special protection afforded frequencies reserved for international aeronautical and maritime safety operations. We note that in many instances amateur frequencies are used for routine communications and hobby activities. While we recognize that amateurs may on occasion assist in providing emergency communications, we believe that the general Part 15 provisions and the specific provisions being adopted herein for Access BPL operations are sufficient to protect these amateur operations.

C. Interference Mitigation

54. In the *Notice*, we proposed to apply certain additional operational requirements to Access BPL systems and devices to address the interference concerns raised in the *Inquiry*.[110] First, we proposed to require that Access BPL systems and devices incorporate capabilities that would allow operators to modify their systems' operations and performance to mitigate or avoid potential harmful interference to radio services. We stated that such adaptive techniques would include, for example, the capabilities to include or exclude, *i.e.*, "notch out," specific operating frequencies or bands, and to reduce power levels on a dynamic or remote controlled basis.[111] We further requested comment on whether we should require that each Access BPL device be capable of operating across a minimum range of frequencies and have the capability to remotely exclude a specific percentage of frequencies within this range. We also proposed to require that Access BPL devices incorporate a shut-down feature that would allow system operators to deactivate specific units found to actually cause harmful interference. We noted that several Access BPL equipment providers were already including these mitigation capabilities in their products and indicated our belief that such capabilities would enable Access BPL operators to avoid causing localized and site-specific harmful interference.

55. NTIA supports our proposals for Access BPL operational requirements.[112] It believes that Access BPL operators, as the parties responsible for eliminating harmful interference, will voluntarily implement equipment, organizational elements, and installation and operating practices that prevent interference and facilitate interference mitigation. NTIA submits that market appeal for Access BPL

[110] *Notice* at ¶40.

[111] *Notice* at ¶37.

[112] *See* comments of NTIA at 8-10.

could quickly evaporate if these systems were to endemically cause interference and have to be shut down. Thus, it believes that Access BPL operators have strong incentives to prevent interference. However, it submits that to preserve the high degree of regulatory certainty enjoyed by licensed radio operators, the rules should require implementation of the most widely effective features for preventing interference, that is, local exclusion of BPL use of specific frequencies or bands, dynamic or commanded power reduction, and commanded shut-down.

56. The American Public Power Association (APPA), Current, Main.Net, NAS/CORF, PowerWAN, Progress Energy, and Southern, also support these proposals.[113] The APPA, Current and PowerWAN state that a requirement that Access BPL systems and devices incorporate capabilities that would allow the operator to modify system performance to mitigate or avoid harmful interference to radio services is desirable, but ask that we not adopt specific mitigation requirements. Southern similarly states that rules should allow for flexibility in the innovation of Access BPL equipment and systems. Though ARINC urges that we refrain from authorizing Access BPL to operate in the Aeronautical Mobile [R] frequency bands, it supports requiring Access BPL to have interference mitigation capabilities such as remote shut-off features and frequency agility.[114]

57. A number of parties representing users of HF and low VHF band radio services submit that our mitigation proposals are not sufficient to protect their operations from interference from Access BPL operations.[115] These parties generally argue that the proposed operational requirements would not serve to prevent interference from occurring, but rather would only provide for after-the-fact remedies. For example, APCO/NPSTC, API, ARRL, and the MSHP argue that our interference mitigation proposals would improperly place the burden of initiation of actions to resolve interference on the victim licensed radio service.[116] APCO/NPSTC and the MSHP express concern that the only way a public safety agency will know that interference is present in a given location will be when a officer cannot communicate in that area.[117] ARRL states that any *post hoc* interference mitigation is impractical in the case of licensed mobile stations. Boeing argues that it would be impractical for an Access BPL system to reduce power levels or shut down operations in time to restore communications between a specific aircraft and a specific HF receiving station.[118] The API also recommends that Access BPL providers be required to act immediately upon receipt of a complaint of interference and to resolve that interference in real time, 24 hours a day/7 days a week.[119] Shipcom LLC, an operator of MPC stations, requests that we require Access BPL operators to shut down their systems within four hours of an interference complaint from MPC receiving stations, airports, airports, military bases, hospitals, and other sensitive facilities.[120] The API and the Potomac Valley Radio Club (PVRC) contend that BPL transmitters should be required to be

[113] *See* comments of APPA at 6; Current at 3; Main.Net at 6; PowerWAN at 2; Progress Energy at 1-2; Southern at 17.

[114] *See* reply comments of ARINC, Section IV.

[115] *See* comments of APPI at 4-11; ARRL at 19-21.

[116] *See* comments of ARRL at 17-21; APCO/NPSTC at 2; MSHP at 3.

[117] *See* comments of APCO/NPSTC at 2.

[118] *See* comments of Boeing at 10 and 12.

[119] *See* comments of API at 4-11.

[120] *See* comments of Shipcom at 3.

shut off as soon as interference is reported.[121] The NAC/Amherst recommend that we clarify the structure of the mitigation measures and how those measures are to be enforced in order that Access BPL operators will have a clearer sense of how they are to be held accountable for any interference they cause.[122] Southern states that the Commission does not specify response times for resolution of interference involving other services and should not do so in the case of Access BPL either.[123]

58. We continue to believe that it is important that Access BPL systems include capabilities that allow them to modify their operations to mitigate or avoid instances of harmful interference that may arise. These capabilities will allow Access BPL system operators to resolve interference found to occur at specific locations or in specific areas of their plant in an expeditious manner and without disrupting service to their broadband service subscribers. We agree with NTIA that Access BPL operators would have strong incentives to voluntarily implement such equipment and operating practices. We also agree with NTIA that, notwithstanding these incentives, it is necessary that we adopt requirements for interference mitigation capabilities to ensure that any interference can be resolved quickly without the need to address the tension that might arise over the possible disruption of service to BPL subscribers if mitigation capabilities were not available. The concerns of those commenting parties who argue that the mitigation requirements would not be sufficient to protect their operations from interference by BPL operations are misplaced. That protection will be provided by: 1) the emissions limits for Access BPL systems; 2) the provisions for consultation areas, excluded bands, and exclusion zones; and 3) the requirement that Access BPL systems not cause interference, as set forth above. The mitigation requirements are intended to ensure that Access BPL systems are designed with features that support interference mitigation, both during initial installation, if sensitive local communications systems are identified in advance, and after installation, when the newly required operational capabilities will allow Access BPL system operators to expeditiously resolve any instances of interference that may occur, without the need to cease operations and thereby disrupt the broadband data services they provide to their subscribers.

59. Accordingly, we are adopting requirements that Access BPL systems incorporate capabilities to modify their systems' operations and performance to mitigate or avoid potential harmful interference to radio services and to deactivate specific units found to actually cause harmful interference that cannot be remedied through modification of their operations as proposed, but with certain modifications. Our approach in specifying these requirements is to provide Access BPL equipment manufacturers and operators with flexibility to design and implement a broad range of products and system designs to meet particular service and operational needs while ensuring that systems have the capabilities to make operational changes to avoid any interference that may arise. The specific provisions of the mitigation requirements and the comments that concern them are addressed below. We also see no basis for subjecting Access BPL systems to requirements for addressing interference complaints that are different and more stringent than our procedures for addressing interference from other types of unlicensed devices. In this regard, we will continue to subject Access BPL systems to the procedures of Section 15.5(c) of the rules. Under this rule, parties who believe they are experiencing interference from an unlicensed device are first expected to bring the matter to the attention of the operator of the unlicensed device. If that action does not resolve the interference, the party may then seek intervention by the Commission.

[121] *See* comments of API at 8 and reply comments of PVRC at 9.

[122] *See* comments of NAC/Amherst at 14-17.

[123] *See* comments of Southern at 32.

60. To be more specific, in the event a BPL interference complaint is filed by a licensee with the Commission, the Commission will contact the complainant and/or the BPL provider to determine if they have first attempted to resolve the interference complaint among themselves. If they have not made such an attempt, the complaint will be forwarded to the BPL provider for action and the complainant notified that they will be contacted by the BPL provider concerning their interference complaint. The Commission may periodically monitor the resolution process to ensure that the parties are working in good faith and making appropriate progress in resolving the interference complaint. If the parties have attempted to address the complaint but the matter remains unresolved, the Commission, through its Enforcement Bureau with assistance from the Office of Engineering and Technology will review the complaint and take appropriate action. In general, the Commission will contact the BPL operator and request information on what steps they have taken to address the licensee's complaint. If these actions are deemed insufficient to resolve the interference complaint, the Commission will instruct the BPL operator to take immediate remedial actions, such as "notching" or avoiding specific frequencies, or ceasing operations.[124] In specific instances, the Commission may undertake field testing and measurements to address interference complaints and determine the most appropriate remedial action.

61. *Frequency Avoidance*. NTIA supports our assessment in the *Notice* that BPL frequency avoidance capabilities can be used to prevent or rapidly diagnose and eliminate interference.[125] It states that to quickly diagnose claims of interference while sustaining Access BPL service, a system operator could simply shift its operating frequency to determine whether its system was causing the interference. NTIA further states that if it is determined that a system is the source of the interference, the system's operation could be reset to use only non-interfering frequencies. NTIA submits that to achieve these benefits, Access BPL systems should be required to be capable of precluding transmissions in bands of at least 3 kHz at frequencies below 30 MHz and 30 kHz at frequencies above 30 MHz.

62. NTIA also suggests that use of adaptive or commanded power control could significantly reduce the risk of interference by maintaining Access BPL signals near the minimum power level needed for service in response to measured or predicted transmission channel.[126] It states that interference risks can be significantly reduced by adjusting power consistent with variations in noise power that cannot reasonably be eliminated prior to Access BPL deployment, rather than simply setting a BPL device's output power at a constant level that is high enough to yield the requisite BPL Signal-to-Noise ratio (S/N) during peak noise levels.[127] NTIA also recommends that Access BPL systems use blocking filters to limit the reach of their transmissions beyond where service is provided.

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[124] *See* 47 C.F.R. § 15.5.

[125] *See* comments of NTIA at 9-10.

[126] *See* comments of NTIA at 9. NTIA notes that power line noise can vary by upwards of 20 dB throughout the day and seasonally, especially at frequencies below 12 MHz.

[127] See comments of NTIA at 9. NTIA also suggests that the Access BPL device multiple access technique and modulation details in addition to the method of power control would sufficiently describe the BPL emission waveforms to enable identification of BPL emissions using a spectrum analyzer. In a letter of September 21, 2004, from Frederick R. Wentland, Associate Chief, NTIA Office of Spectrum Management, to Ed Thomas, Chief of the Commission's Office of Engineering and Technology, NTIA states that it does not support a requirement for Access BPL systems to transmit identification codes or call signs. NTIA indicates that such codes would unacceptably increase interference risks.

63. Access BPL proponents generally argue that Access BPL providers should have the flexibility in designing their own mitigation techniques.[128] These parties generally hold that while the specific techniques and practices suggested by NTIA are desirable features for mitigating interference from Access BPL systems, we should not mandate them by rule. For example, the APPA, AT&T, PowerWAN, Progress Energy, and Southern submit that particular specifications for range of frequencies and other specific control mechanisms are not necessary because the modulation techniques that make Access BPL operation feasible are by their nature adaptable. Southern agrees with NTIA that power reduction at specific devices and or specific frequencies should be considered as an option for mitigating interference. It also agrees with NTIA that techniques such as frequency avoidance, using balanced differential BPL signal injection, and using blocking filters to limit the reach of BPL signals beyond where service is provided could also be useful components in interference mitigation. However, its states that the viability of any of these techniques will depend on the type of technology and network and that we should therefore provide flexibility for system operators.[129] AT&T similarly states that requiring specific mitigation techniques and procedures would not be appropriate because each system will have different operational parameters, including the frequencies used, the equipment deployed, the geographic scope of the deployment, and the surrounding topographies. AT&T, Duke Energy and PowerWAN also argue that any requirements for frequency notching and remote control power reduction should be applied prudently, as the cost and complexity of equipment will be affected as more requirements are specified. Duke Energy states that mandating all or even some specific interference mitigation capabilities be available on every piece of BPL equipment could result in wasted resources.[130]

64. NAS/CORF supports the use of notching of Access BPL signals to protect radio astronomy stations. It states that such notching should ensure that Access BPL emissions in the HF and low VHF radio astronomy bands do not exceed 100 μV/m at 3 meters. The ARRL contends that dynamic frequency selection capabilities will not work because that technology only responds to transmitted signals heard, and these capabilities are not sensitive enough to hear the weak signals that a licensed station is attempting to receive.[131] The ARRL, API, Boeing, IMSA, MSHP and SBE request that Access BPL systems be required to notch the bands used by their services, and REC Networks asks that we require Access BPL systems to notch all licensed radio bands in the 2-80 MHz bands.[132] Anthony Good, Boeing, and Tracy K. Wood recommend that we require Access BPL devices to incorporate "marker beacons" that carry identifying data for use in tracing interference.[133] Boeing states that absent such markers, there is no way for aeronautical operators to identify the source of Access BPL signals.[134]

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[128] *See* comments of AT&T at 5-6, APPA at 5, PowerWAN at 2, Progress Energy at 6, and Southern at 18-19; *see also*, reply comments of Ameren at 11 and Con Edison at 5; *see also* reply comments of Current at 21-25.

[129] *See* reply comments of Southern at 34.

[130] *See* reply comments of Duke Energy at 15-16. For example, it would not be cost-effective or necessary to require underground devices to incorporate a host of mitigation capabilities, as interference concerns are greatly reduced due to the shielding that would naturally or inherently occur.

[131] *See* comments of ARRL at 21.

[132] *See* comments of ARRL at 21, API at 7, Boeing at 2, IMSA at 4, MSHP at 6, REC Networks at ¶¶ 3-4., and reply comments of SBE at 5.

[133] *See* comments of Tracy K. Wood at 4-5, Anthony Good at 2.

[134] *See* comments of Boeing at 13.

65. We conclude that the most appropriate approach regarding mitigation techniques that involve altering system operation is to require that Access BPL systems incorporate the capability to avoid the use of specific frequency bands. The ability to alter a system's operation to notch-out transmissions from specific frequencies where interference is occurring is a necessary feature for resolving interference without disrupting service to BPL subscribers. While other mitigation capabilities, such as adaptive or commanded power control, are desirable system features that can serve to reduce interference potential, they generally would provide a much lower degree of benefit in eliminating interference than frequency avoidance. Limiting the requirement for operational modification capabilities to frequency avoidance is also consistent with our intent to minimize the impact of these requirements on manufacturers and system operators so as preserve their flexibility to design products and systems that will best meet the needs of Access BPL subscribers.

66. In considering specifications for the notching requirement, we find that the most important consideration is to ensure that the notch provides enough filtering to effectively reduce the potential for interference. Our experience in examining the field performance of various Access BPL operations indicates that at frequencies below 30 MHz, a notching capability that provides at least a 20 dB reduction of Access BPL emissions below the current applicable Part 15 emission limits is adequate to resolve interference occurrences that might result to mobile reception from such operations. In this regard, we will generally assume that a 20 dB notch is sufficient to resolve any harmful interference that might occur to mobile operations, given the low signal levels allowed under the Part 15 emission limits and the fact that a mobile transceiver can readily be re-positioned to provide some separation from the Access BPL operation. The interference potential from emissions at this low level would be limited to a very short range from an Access BPL device or a power line on which Access BPL transmissions are carried. We also believe that notching at this level with some distance separation will generally avoid interference to fixed operations, including those that use more sensitive receivers.[135] Above 30 MHz we believe that a notching capability of at least 10 dB is sufficient to provide the same level of protection, given the more stringent Part 15 emission limits that apply to Access BPL transmissions above 30 MHz and the increased attenuation of emissions that occurs from propagation losses as the frequency of operation increases.[136] With regard to NAS/CORF's requests for protection of radioastronomy, we note that special protections are provided for radioastronomy in the exclusion zones and consultation requirements for Access BPL as set forth above.

67. We do not believe it is necessary to specify the bandwidth over which the notching capability must function. Rather, we will adopt the more general requirement that Access BPL systems must be capable of avoiding transmissions in any frequency band or bands in order to eliminate any instances of interference with the operations of licensed radio services. We therefore are amending our rules to require that Access BPL devices have the capability to reduce emissions by at least 20 dB below the Part 15 emission limits in frequency bands below 30 MHz and 10 dB below those limits in frequency bands 30 MHz and above. We believe that these provisions adequately set forth the structure of the required capabilities for modifying the operation of an Access BPL system. We are not specifying requirements for use of the frequency avoidance capabilities. Rather, we believe that system operators should have the discretion to use this capability or any other alternative available to them as they might deem appropriate

[135] Under this requirement, Access BPL systems will have to be able to limit their emissions in bands selected for frequency avoidance to 50 dBμV/m at frequencies from 1.705 to 30 MHz and 30 dBuV/m at frequencies above 30 MHz. These values apply for measurements at 3 meters.

[136] For example, the free space propagation loss between two isotropic antennas separated by 100 meters is approximately 18.5 dB at 2 MHz, 32 dB at 10 MHz, 38 dB at 20 MHz, 42 dB at 30 MHz, and 50 dB at 80 MHz.

to resolve specific situations involving interference that they may encounter in the course of their operations.

68. We do not find any justification for a requirement that Access BPL operators notch the frequencies of any or all of those services that use frequencies in the HF and low VHF bands. As stated above, we believe that the emission limits, consultation areas, excluded bands, exclusion zones, and the requirement that Access BPL systems not cause interference, as set forth above, are generally sufficient to control the interference potential of these systems. The required notching capability will enable a system operator to address any specific instances of interference that might otherwise arise. We also decline to adopt a rule requiring transmission of identification codes. As NTIA states, such codes could increase the potential for interference from Access BPL operations. We also do not believe that it would be practicable for ARINC or any other operator to identify an Access BPL system as the source of interference and contact its operator on a real time basis to resolve the interference. As NTIA indicates in its letter of September 24, 2004, no practical method has been identified for Access BPL systems to transmit an identifying code. We believe that the Access BPL notification requirements, as described below, will provide sufficient information to locate and mitigate interference.

69. *Shut Down Requirement.* NTIA submits that in addition to providing a means for final resolution of interference, a shut-down feature could be used to rapidly test whether the system is causing interference. It states that a simple on-off test using the shut-down feature would serve to indicate whether the system was the source of observed interference. NTIA states that a shut-down requirement is also practicable and effective. In this regard, NTIA submits that in the course of conducting its BPL measurements, its personnel requested shut-downs and confirmations of BPL frequency usage via telephone and these requests were executed within a matter of seconds under pre-arranged conditions. It states that while such speedy responses may not be routinely practicable in response to complaints of suspected interference, a requirement to be capable of shut-down of Access BPL network elements coupled with system operators' incentives to preclude filings of interference complaints with the Commission should yield prompt resolution of cases of Access BPL interference. NTIA also indicates that shut down should be the last resort if other mitigation techniques are ineffective in resolving interference.[137]

70. The AMA, ARINC, ARRL, API, and Boeing support our proposal to require that Access BPL systems incorporate a shut-down feature that would allow deactivation of units found to cause harmful interference. For example, ARINC and Boeing recommend that the rules require, at a minimum, that Access BPL system devices incorporate circuitry allowing operators to remotely turn their devices on and off.[138] Boeing notes, however, that it would be impractical to expect an Access BPL network to shut down operations in sufficient time to restore communications between a specific aircraft and a specific HF receive station on a case-by-case basis.[139] The ARRL, API and AMA also ask that we require Access BPL operators to notify their customers in advance of possible service interruptions resulting from interference mitigation.[140]

71. Other parties ask that we clarify that interference mitigation techniques may be implemented in the first instance and that the shut-off feature should be used as a last resort. In their reply comments,

[137] *See* comments of NTIA at viii.

[138] *See* reply comments of ARINC at 7.

[139] *See* comments of Boeing at 10 and 12.

[140] See comments of ARRL at 24, API at 11 and AMA at 6-7. *See also* reply comments of PVRC at 13.

Con Edison, Duke Energy, Southern, and the UPLC submit that Access BPL operators should be permitted to correct harmful interference by notching or shifting frequencies prior to having to shut down an Access BPL device.[141] Progress Energy suggests that any mandatory shut-down capability be specified as manually controlled because any automated shut-down capability could have detrimental effects on a power utility service's operations in addition to disrupting broadband service to its Access BPL customers.[142] Ameren opposes the proposed requirement that Access BPL equipment include a shut-down feature that allows deactivation of units found to be causing interference.[143] It argues that this feature would add unnecessary cost and complexity to equipment and suggests that we instead rely on the requirements for no interference in Section 15.5 to address interference.

72. We continue to believe that Access BPL equipment and systems should have the capability to deactivate individual system components. This feature will allow systems to deactivate limited portions of their plant so that localized interference problems can be addressed without affecting service to all of their subscribers. As a secondary benefit, the shut-down feature will allow system operators to rapidly diagnose whether their operations are causing reported interference. We are also requiring that the shut-down feature in individual devices be remote-controllable from the central system operations facility or other appropriate location. This will allow rapid response to resolve interference in any emergency or other urgent situation that might arise. We also agree with Progress Energy the required shut-down capability should be manually controlled. Moreover, we have no record on which to base a decision on the conditions under which an automated capability would be activated. We also recognize that, depending on how it would be triggered, an automated shut-down capability could unnecessarily have detrimental effects on a power utility service's operations in addition to disrupting broadband service to its Access BPL customers.

73. It is not our intention that a service shut-down be the first step in a system operator's response to a valid interference complaint. As suggested by several of the commenting parties, we would anticipate that shut-down would be a last resort when all other efforts to satisfactorily reduce interference have failed. We disagree with Ameren that the shut-down requirement will add unnecessary costs and complexity to Access BPL equipment. As NTIA and our own field testing indicate, most Access BPL systems and equipment already include the capability to shut-down specific components of their operation. Accordingly, we are requiring that Access BPL systems incorporate features that will allow the deactivation of individual components on a remote controlled basis, to be implemented and used as discussed above. We reiterate, however, that the Commission, through a duly authorized representative, is the sole authority that may direct an Access BPL operator to cease operating any of its devices to eliminate interference.[144]

D. Access BPL Notification and Database Requirements

74. In the *Notice*, we proposed to subject Access BPL systems to a notification requirement similar to the notification requirements in our rules for power line carrier (PLC) systems.[145] Under this

[141] See reply comments of Con Edison at 4, Duke Energy at 46, Southern at 17 and 31, and UPLC at 10.

[142] *See* comments of Progress Energy at 6.

[143] *See* comments of Ameren at 8-9.

[144] *See* 47 C.F.R. § 15.5(c).

[145] See 47 C.F.R. § 15.113 and 47 C.F.R. § 2.106, Note US294. Under the existing rules, information on power line carrier systems must be entered into a database administered by United Telecom Council (UTC).

requirement, an Access BPL system operator would submit information on its system to an industry-operated entity. This entity would establish a publicly accessible database for Access BPL information to ensure that the location of Access BPL systems and their operating characteristics can be identified if harmful interference occurs and to facilitate the activation of interference mitigation and avoidance measures. As proposed, this notification would include information on the location of the installation, the type of modulation used, and the frequency bands of operation. We sought comment on these proposals including suggestions on the appropriate industry-operated entity that should be selected to receive the notifications and maintain the Access BPL data base. In addition, we asked for suggestions regarding other approaches for making this information available and for input on whether it would be more reasonable to allow each Access BPL operator to maintain a database of its own rather than require a more centralized data base. We further sought input on the burden that the proposed notification requirement would place on entities operating Access BPL systems, and any impact of a notification system on the availability of customer data, as well as how any concerns regarding the proprietary nature of that data can be addressed.[146]

75. NTIA supports a requirement that BPL operators notify key BPL system parameters to an industry database. NTIA states that the database will serve to facilitate prior consultation of Access BPL deployments with licensed radio users.[147] NTIA suggests that by entering planned new Access BPL deployments in the data base at least 30 days in advance of consultation, concerned radio operators could inform BPL system operators of local radio operations that may be affected and that the system operators could consult with potentially affected parties as necessary in order to prevent interference. NTIA recommends that notification of the earliest anticipated date of actual operation within each deployment area should be included in any notification so that NTIA can properly prioritize its responses to Access BPL notifications. NTIA states that in response to each advance notification, it plans to provide the BPL operator with information that will enable prevention of interference to local federal radio operations.

76. NTIA recommends for each deployment area that Access BPL operators specify the maximum number of each type of Access BPL device to be deployed in the specified area and that subsequent notifications should be submitted at least quarterly for each deployment area, as needed, to report the total numbers of each type of device that have been deployed and to update other advance notification parameters.[148] NTIA also indicates that Access BPL system notifications should include information on the modulation type(s), number(s) of carriers, minimum and maximum carrier spacing, symbol rate(s) per carrier, range of transmission duty cycle, and the multiple access technique.[149] NTIA also recommends that planned BPL system locations be notified in the form of one or more geographic coordinates (in decimal degrees) and associated radii (in kilometers). Finally, NTIA recommends that each notification of BPL deployment include a single telephone point of contact for each deployment area and an e-mail address. NTIA asserts that the telephone point of contact should be required to receive complaints of suspected interference and be capable of accomplishing rapid diagnosis during the same telephone session, or shortly thereafter, by a mutually agreed schedule.[150]

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[146] *Notice* at ¶43.

[147] *See* comments of NTIA at 9-11.

[148] *See* comments of NTIA at 11-12. NTIA states that over time this data would assist in updating its predictions of increases in ambient radio noise due to ionospheric propagation and aggregation of emissions from BPL devices.

[149] *See* comments of NTIA at 12.

[150] *See* comments of NTIA at 13.

77. A number of potential Access BPL providers and proponents generally support the creation of a publicly accessible database, as proposed in the *Notice*. Southern recommends that each BPL operator provide to an industry-operated entity a list of zip codes where BPL is deployed, the range of frequencies over which its BPL system operates and a point of contact to whom interference complaints should be sent. Anyone experiencing interference could query the database which would return general information on deployed BPL systems and direct the complainant to a contact name and phone number at the BPL operator's company.[151] Main.Net and Earthlink recommend that the information submitted to the database include only the city or town where the BPL system is deployed, the responsible power utility or BPL operator, and a toll free contact number.[152] Duke Energy recommends that disclosures and database access be limited to the minimum necessary to place a licensee in touch with the appropriate BPL operator to cooperatively diagnose and remedy harmful interference issues.[153]

78. Some parties raise concerns that a publicly available BPL database, or the inclusion of more detailed information in the database, could compromise sensitive or critical information about the electric power grid. UPLC supports the FCC's proposal of a notification database, but only to the extent that public disclosure of information is limited to that which is necessary to effectively resolve interference without providing sensitive information that could compromise critical infrastructure.[154] APPA states, for example, that the database proposal raises serious national security issues and it urges the Commission to adopt a notification rule that does not require the disclosure of sensitive information.[155] HECO recommends the use of a secure, independent database custodian to guard potential risks of disclosure of critical infrastructure, as defined by FEMA.[156] PPL Telcom argues that in the near future, BPL may be used for electric utility supervisory control and data acquisition (SCADA) communications and public disclosure of BPL locations and operating frequencies would expose electric utility operations to risk through deliberate degradation or interruptions of the SCADA communications carried by BPL.

79. Other parties argue that providing detailed information on BPL deployment also raises competitive issues. Cinergy, for example, states that creating a publicly accessible database would provide entrenched broadband providers with free competitive intelligence about a BPL provider's network build-out, and would permit them to target marketing and promotion efforts in an attempt to pre-empt BPL provider's offers.[157] Cinergy is also concerned that the database could lead to abuses and be used to file meritless interference complaints against access BPL operations.[158] Similarly, PLL Telecom is concerned that broadband competitors would obtain an unfair advantage in the marketplace through access to a database that would reveal BPL growth plans and marketing strategies.

80. A number of parties, on the other hand, recommend that the database contain more detailed information on BPL operations. AMA supports making public information on the location of all BPL

[151] *See* comments of Southern at 10-11.

[152] *See* comments of Main.Net at 8. *See* reply comments of Earthlink at 2.

[153] *See* reply comments of Duke Energy at 12.

[154] *See* comments of UPLC at 10.

[155] *See* reply comment APPA at 2 and comments at 9.

[156] *See* comments of HECO at 4.

[157] *See* comments of Cinergy at 4.

[158] *See* comments of Cinergy at 4.

transmitters, and argues that such information would not disclose critical infrastructure facility locations or present competitive concerns.[159] It notes vendors in the market readily disclose where they offer service and commonly do so on their internet web sites. AMA adds that a database that is not public is of little use in planning operations and avoiding interfering conditions.[160] CEA believes that it is prudent to include the power spectral density mask that represents the maximum power transmitted by the system for any given frequency in addition to location, modulation and frequency band of the BPL operations.[161] The PVRC also asserts that information on Access BPL would constitute the same information typically available in equipment brochures or websites and should not be viewed as a source of competitive disadvantage.[162] Anthony Good states that having a public database of BPL systems will enable interference victims to properly identify the operators of interfering BPL systems and file complaints.[163] SBT recommends that the database include mapping software that is sufficiently detailed to show the exact locations of the lines over which BPL is traveling.[164]

81. ARRL supports NTIA's proposal that BPL operators provide a single point of contact for each deployment area that can effectuate immediate interference diagnosis and resolution. ARRL notes, however, that the single point of contact would not facilitate resolution of interference to mobile stations.[165] ARRL, ARINC and others assert that Access BPL operators should be required to provide points of contact fluent in all major languages that are reachable 24 hours a day/seven days a week in order to allow parties using international broadcast services to report interference complaints.[166] ARINC also states that those points of contact must be capable of remotely initiating the steps needed to ascertain whether the interference complaints are likely due to Access BPL operations and be empowered to dispatch personnel to troubleshoot any complaints that cannot be resolved remotely.[167] Southern, in its reply comments, objects to a requirement to have multilingual employees so that BPL operators could address interference complaints from non-English speaking shortwave radio listeners. It states that such a requirement is unreasonable and would place it and other BPL providers at a disadvantage to other communications service providers.[168] Duke Energy states that it is unreasonable and unnecessary to require BPL operators to staff a hotline and maintain field personnel to address interference concerns instantaneously during non-business hours on a non-emergency basis.[169]

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[159] *See* reply comments of AMA at 3-4.

[160] *Id.*.

[161] *See* comments of CEA at 7.

[162] *See* reply comments of PVRC at 10.

[163] *See* reply comments of Anthony Good at 2.

[164] *See* comments of SBT at 8.

[165] *See* reply comments of ARRL at 21.

[166] *See* reply comments of ARINC at 2 and comments of ARRL at 23; North American Shortwave Association at 5; Small Business in Telecommunications at 7-9; and Tracy K. Wood at 5.

[167] *See* reply comments of ARINC at 8.

[168] *Id.* at 32.

[169] *See* reply comments of Duke Energy at 12.

82. At least two parties, UPLC and Comsearch, offer to provide BPL notification database administration services.[170] UPLC states that it has the resources and the experience from its relationship with the United Telecom Council (UTC) to effectively serve as the BPL database administrator.[171] Comsearch states that it has extensive experience in maintaining state of the art software and databases for mobile, microwave and satellite communications systems.[172] Comsearch also states that its position as an independent third party would address concerns raised by certain parties that the database administrator not be associated with the utilities providing BPL service. Comsearch indicates that is feasible for a third-party entity to perform the database notification functions as well as interference analyses and interference resolution without releasing information in bulk.[173] NAC/Amherst agrees with Comsearch that the proposed BPL database should be administered by a third party rather than the BPL service industry itself or its members. It states that the FCC should permit interested non-profit organizations as well as private sector parties that have no connection to the BPL industry to compete for the position. NAC/Amherst recognize that such an entity would need to be compensated for its services and suggests that the Commission establish a surcharge on the sale or lease of BPL services, facilities and/or equipment to provide revenue for the third party entity.[174]

83. *Decision.* We continue to believe that the Access BPL notification and database requirements proposed in the *Notice* are appropriate and sufficient to ensure that any potential interference to licensed services from BPL operations can be adequately identified and quickly addressed. The primary intent of our notification and database requirements is to ensure that licensed users of the spectrum have a publicly accessible and centralized source of information on BPL operations to determine whether there may be Access BPL operations on particular frequencies within their local area so that any incident of harmful interference can be resolved should it occur. The information contained in the notification database need only be sufficient to determine whether there may be a BPL operation in the local area, the nature of the BPL operations, whether the BPL system is operating on frequencies that could potentially be a source of harmful interference to the licensed user and to identify an appropriate contact person who can work directly with the complainant to resolve the harmful interference if it is determined to be caused by the local BPL operations. Additional or more detailed relevant information needed by a radio operator could be requested via the contact person indicated in the data base, as appropriate.

84. We therefore are adopting rules that will require the BPL industry to establish within 180 days from publication of this item in the *Federal Register* a centralized publicly accessible Access BPL notification database.[175] We note that two organizations have indicated their willingness to perform this task and that the issue of "independence" of the database manager has been raised by some of the commenting parties. The responsibilities and duties of the database manager are to maintain complete,

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[170] *See* comments of UPLC at 12 and reply comments of Comsearch at 3.

[171] Under the existing rules, information on power line carrier systems must be entered into a database coordinated by the United Telecom Council, formerly Utilities Telecommunications Council, (UTC), the designated coordinator and database operator for power line carrier systems. *See* 47 C.F.R. §§ 15.113 and 90.35(f). *See also* footnote 58 and comments of UPLC at 12-13.

[172] *See* reply comments of Comsearch at 3.

[173] *Id.*, at 2-3.

[174] *See* reply comments of NAC/Amherst at 5 and additional reply comments at 2-3.

[175] Prior to the time the Access BPL industry database manager is established and the database operational, we encourage Access BPL operators to make available the notification information on an individual basis.

accurate and timely records of FCC-mandated information. We are not requiring, as some parties have suggested, that the database manager be involved in, monitor, or manage the interference resolution process. The party responsible for avoiding interference is clearly the Access BPL operator and his responsibilities are clearly set forth in the existing procedures under Section 15.5(c) of the Commission rules. We therefore do not find that the database manager need be an "independent" third-party with no relationship to the BPL or utility industry and are not adopting such a requirement.

85. With regard to the information to be included in the database, we are adopting rules that require the Access BPL operator to provide the BPL industry designated database manager with the following information 30 days prior to initiation of any operation or service: 1) the name of the Access BPL provider; 2) the frequencies of the Access BPL operation; 3) the postal zip codes served by the specific Access BPL operation; 4) the manufacturer and type of Access BPL equipment being deployed (i.e., FCC ID); 5) point of contact information (both telephone and e-mail address) for interference inquiries and resolution; and 6) the proposed/or actual date of Access BPL operation.[176] The database manager shall be required to enter this information into the publicly accessible database within 3 business days of receipt. This will allow some period of time for the database manager and BPL provider to address any questions with regard to information submitted and to ensure that information entered into the database is correct. We believe that the above information provides sufficient specificity for identifying potential interference while at the same time avoiding valid concerns that sensitive information on critical infrastructure not be revealed.

86. We believe that using zip codes, as suggested by Southern, would sufficiently identify the area of Access BPL deployment without revealing specific sensitive information and would facilitate a more organized approach to identification and resolution of harmful interference. We note that zip codes are easily understood and can be identified by both licensees and BPL operators. With regard to those parties that request more comprehensive information, we do not find that benefits of providing such information in the database would outweigh the substantial cost of collecting and reporting this additional information. We note, for example, that NTIA's proposals to require information on modulation types, number of carriers, range of transmission duty cycle, minimum and maximum carrier spacing, symbol rates per carrier, etc., would provide little additional guidance on whether interference were being caused in a particular instance as compared to the more simple requirement of identifying BPL operating frequencies. In addition, we are requiring herein that BPL equipment must be certified and therefore more detailed technical information will be available through our equipment authorization files for those parties desiring such information. We also are not requiring Access BPL operators to have multi-lingual contact persons. We believe that requiring both telephone and e-mail contact information is sufficient to address interference inquiries. We are also not requiring that telephone contact positions be staffed 24 hours per day and seven days a week. We believe that our emission requirements and other mitigation rules will ensure that interference is generally avoided. We believe that telephone contact staffing during normal business hours is sufficient and also note that e-mail would generally allow interference reports to be filed at any time.

87. We expect the Access BPL operators and licensees to cooperate in good faith to identify and resolve instances of harmful interference. We require the notification database for Access BPL operators to notify the operation of its devices and systems to facilitate the speedy resolution of interference. Speedy resolution of interference will not result if the database information on Access BPL deployments is abused and the BPL operators are deluged with frivolous interference complaints. We expect the

[176] Once the 30-day advance notification timeframe is over, the Access BPL operator can begin operations. However, the Access BPL operator must notify the database manager of the date of commencement of actual operations for inclusion in the database.

Access BPL operators to take every complaint of interference seriously and to diagnose the possible cause of interference quickly. At the same time, we expect the complainant to have first taken reasonable steps to confirm that interference rather than a receiver system malfunction is occurring and, to the extent practicable, to determine that the interference source is located outside the complainant's premises. We expect both parties to cooperate to determine a mutually acceptable schedule to diagnose and resolve the interference complaint, recognizing that the Access BPL operator may have to prioritize any complaints of interference that it receives (e.g. from a public safety agency). With regard to public safety operations, however, we will require that the BPL operator respond to complaints of harmful interference from public safety users within 24 hours; the BPL provider shall be required to immediately cease the operations causing the public safety complaint if it fails to respond to such complaint within 24 hours. Any complaints of interference that are not resolved in accordance with the mutually agreed schedule may be filed with the Commission along with the particulars of the interference case. Upon receipt of the interference complaint, the Commission will investigate the complaint and take action against the Access BPL operator if it is found to be causing harmful interference. If, on the other hand the Commission uses its resources to investigate an interference complaint that is found to be frivolous, the Commission will impose appropriate sanctions for abuse of its administrative process.

E. Measurement Guidelines

88. In order to ensure that emissions from Access BPL systems are accurately measured, in the *Notice*, we proposed specific measurement guidelines for both Access BPL and all other carrier current systems. In doing so, the Commission also fulfills a deferred promise from another docket.[177]

1. Access BPL Systems

89. In the *Notice*, we proposed to require that Access BPL systems, including all of their component electronic devices, *e.g.*, couplers, injectors, extractors, repeaters, boosters, concentrators installed on the electric utility overhead or underground medium voltage lines etc., be measured *in situ* to demonstrate compliance with our Part 15 rules. As proposed, such measurements would be made at a minimum of three overhead and three underground representative locations, using the measurement guidelines in Appendix C of the *Notice*.[178] For Access BPL systems in underground installations, the proposed guidelines employ the common principle of measuring radiated fields along a number of radials at a specified distance from the periphery of the pad-mounted above-ground transformer where the Access BPL equipment is located to find the maximum emissions. For Access BPL systems installed on overhead lines, in order to take into account the effect of the long power line, the proposed guidelines specify measurements at fixed horizontal distances from the power line where the Access BPL signal injection source is installed. Thus, rather than finding the maximum emissions across a number of radials, - as currently performed for other Part 15 emitters – the proposed guidelines specify that the receive antenna be moved down-line, parallel to the power line, starting from the Access BPL signal injection equipment location, to find the maximum emissions at each frequency within the requisite frequency range of the Access BPL device; the minimum down-line distances at which measurements are to be taken in this sequence are specified in terms of the wavelength of the Access BPL mid-band

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[177] *See 1998 Biennial Regulatory Review - Conducted Emission Limits Below 30 MHz for Equipment Regulated under Parts 15 and 18 of the Commission's Rules,* ET Docket 98-80, *Report and Order*, 17 FCC Rcd 10806 (2002) at ¶2. In that proceeding, the Commission deferred the measurement procedures for carrier current systems to a future proceeding.

[178] *Notice* at ¶45 and Appendix C, *Notice* at 30-33.

frequency.[179] The proposed guidelines also allow the use of the existing distance extrapolation factors for measurements made at distances other than the specified distance in the rules.[180]

90. In addition, we specifically solicited comments on the height of the receive antennas used for measuring radiated emissions from Access BPL systems operating on overhead power lines and on the possible use of correction factors to account for the height of these antennas. The proposed guidelines in Appendix C of the *Notice* recommend measuring with a fixed *loop* antenna at 1 meter height for frequencies below 30 MHz and varying the height of electric field sensing antennas (*e.g.*, a dipole) from 1 to 4 meters for measurements at frequencies above 30 MHz. We stated that while these recommendations correspond to standard practice for other types of devices (especially when measured on a test site), these heights may not capture the maximum emissions from an overhead power line. In Appendix C of the *Notice*, this issue was addressed by proposing that distance extrapolations for emission measurements on overhead lines be based on slant-range distance from the overhead power line to the measuring antenna, rather than on horizontal distance.[181] We remarked however that this technique does not account for field strength reductions caused by ground effects, and sought comment on whether it is necessary to require that emission measurements be conducted at antenna heights greater than those proposed in Appendix C. We also asked whether it is practical and safe to make *in situ* emission measurements with an antenna up to the height of an overhead medium voltage power line (typically 11 meters) when operating 10 meters from the power line. As an alternative to requiring measurements at higher antenna locations, we asked whether we should specify that measurements that are performed at heights significantly lower than the power line are subject to a correction factor to estimate the maximum field strength that would have been observed at a higher measurement height; and how should such a correction factor be determined.[182]

91. *NTIA Phase 1 Study, Comments and Follow-Up Letters.* As mentioned, *supra*, NTIA submitted an extensive report on BPL (the NTIA Phase 1 Study), addressing several issues dealing with emission measurements for Access BPL. This study addressed interference risks to radio services, and suggested means of reducing these risks and identifying techniques for local interference mitigation.[183] In this study, NTIA conducted testing at locations of actual Access BPL installations and performed theoretical modeling using the Numerical Electromagnetic Code (NEC) software. Using the NEC software, NTIA evaluated interference risks in terms of the geographic extent of locations where interference may occur to radio reception. These evaluations were performed at four frequencies for outdoor, overhead Access

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[179] *Id.*

[180] The rules allow using a 20 dB per decade distance extrapolation factor for frequencies above 30 MHz and 40 dB per decade distance extrapolation for frequencies below 30 MHz. Thus, if the rules specify a radiated emission limit of 100μV/m at 10 meters, if the measurement was made at 3 meters for a frequency of 20 MHz, a correction factor of 20.9 dB (40 log (10/3)) would be subtracted from the measurement data to account for the difference in measurement distances. *See* 47 C.F.R. § 15.31(f)(1) and (2). *See also,* footnote 181, *infra.*

[181] *See* 47 C.F.R. § 15.31(f)(1) and (2). The extrapolation factor is used to address the difficulty of making measurements at large distances. "Decade", a 10:1 range, refers to the ratio of the specified measurement distance to the actual measurement distance. For example, in the 1.705-30 MHz band, measurements are specified at a distance of 30 meters. If however, actual measurements were made at a distance of 3 meters, the ratio of the distances is a decade (30/3=10) and the field strength result must be corrected by subtracting 40 dB.

[182] *Notice* at ¶46 and *Notice*, Appendix C at 31-33.

[183] *See* footnote 1.

BPL systems conforming to existing Part 15 rules.[184]

92. The NTIA Phase 1 Study concludes that the most effective approach for reducing BPL interference risks would be to establish proper compliance measurement procedures, and that measuring Access BPL emissions in accordance with the existing Part 15 measurement provisions can mistakenly indicate compliance with field strength limits when the limits actually are substantially exceeded. NTIA recommends several modifications to the proposed emission measurement guidelines to ensure that maximum emissions are measured. In its study, NTIA recommends: 1) measuring an Access BPL device at a fixed measurement distance of 10 meters; 2) using a measurement height approximately equal to the power line height, however, it also suggests that a small adjustment factor would still be necessary to account for higher emissions at even higher elevation angles; 3) making measurements below 30 MHz with a rod antenna rather than the FCC and industry practice of using a loop antenna. NTIA also provides some recommendations for the selection of the three representative measurement sites, including requirements for a variety of power line configurations (*e.g.* single phase, three-phase, sharp turns, transitions to underground cables, etc.). NTIA also indicates that these recommendations are still under study, and that additional suggestions will be presented in the Phase 2 of the study. The study also contains a recommendation for a smaller distance extrapolation factor than that specified by the existing Part 15 rules, but which is also under study.[185]

93. Subsequently, NTIA submitted comments that were accompanied by a Technical Appendix containing preliminary results and recommendations from Phase 2 of its study. In those comments, NTIA modifies some of the assessments in the NTIA Phase 1 Study, and supersedes them with specific recommendations, aiming at shifting emphasis away from eliminating interference and toward preventing it, premised on the fact that BPL operators have a market incentive to prevent interference.[186] In its letter of September 24, 2004, NTIA reported the findings of its further studies of measurement guidelines.

94. *a) Measurement Distance.* NTIA stated that its measurements and modeling indicate that the change in BPL field strength with increasing distance from a BPL device and overhead power lines is not well approximated by the existing Part 15 distance extrapolation factor when measuring distances horizontally (rather than using slant range to the power line as proposed in Appendix C of the *Notice*). NTIA's recommended solution to this anomaly is to uniformly apply a ten-meter standard measurement distance to such installations, present explicit equivalent field strength limits for those distances, and provide an appropriate distance extrapolation factor. We note that while NTIA, in its comments, indicated that it was still developing equivalent field strength limits and distance extrapolation factors on the basis of the radiation and propagation properties of Access BPL emissions, it subsequently informed the Commission that it has now completed its studies of these issues and it has arrived at the same conclusions as we arrive at below.[187]

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[184] *NTIA Phase 1 Study,* at v and vi.

[185] *See* 47 C.F.R. § 15.31(f)(1) and (2). 47 CFR 15.31(f) applies 20 dB per decade for frequencies above 30 MHz and 40 dB per decade for frequencies below 30 MHz as distance extrapolation factors to adjust field strength measured at a distance other than the specified measurement distance. *See also,* footnote 181.

[186] *See* NTIA Comments at 8-9.

[187] *See* NTIA Comments at 16-17; *see also* letter of September 24, 2004 from Frederick R. Wentland, Associate Chief, NTIA Office of Spectrum Management, to Ed Thomas, Chief of the Commission's Office of Engineering and Technology.

95. *b) Receive Antenna Height and Height Correction Factor.* NTIA's initial analysis of radiated emissions from overhead Access BPL systems shows that relatively high emissions can occur at various distances from a BPL device along a power line, in some cases at regular distance intervals. Thus, the peak field strength level can occur at any fraction or multiple of a wavelength from the BPL emitter.[188] NTIA therefore submits in its comments that measurements taken at distances along the power lines that are fractions of a wavelength, as proposed in the *Notice*, will fail to reveal the peak field strength in many cases. To prevent underestimation of peak field strength during compliance measurements, in its comments NTIA recommends a comprehensive search for the peak field strength along the power lines at a height of one-meter. In its September 24, 2004 follow-up letter, NTIA supports the procedure in the *Notice* because it will not significantly underestimate the peak field strength.[189]

96. c) *Height Correction Factor.* To avoid the need to search for the peak field in the height dimension as well, NTIA recommends use of a 5 dB height correction factor. Using NEC models, NTIA evaluated the distributions of heights and the magnitudes of peak field strength from over one-thousand combinations of nineteen power line configurations, polarization and location, at each of twenty-five BPL operating frequencies. This analysis revealed that 80 percent of the local field strength peaks at any height will be within 5 dB of the peak electric field strength measured along the power line at a height of one meter. In the large number of potential cases modeled by NTIA, the maximum field strength at any polarization over all cases exceeded the peak value measured one-meter height by up to 20 dB in small spatial regions. NTIA believes that the use of the 80 percentile value of 5 dB rather than the 100 percentile value of about 20 dB would avoid undue constraint on BPL systems without significant impact on interference risks. Thus NTIA states that use of a 5 dB height correction factor with the peak field strength measured at a one-meter height is a good estimate of the electric field strength not exceeded at 80% of the heights above one-meter.[190] Based on its further studies, NTIA reported in its September 24, 2004 letter that this height correction is not needed below 30 MHz and that above 30 MHz, the 5 dB height correction could serve as an alternative to varying the measurement antenna height as proposed in the *Notice*.

97. *d) Type of Antenna Used for Testing.* NTIA concurs with our proposal to use a loop antenna at frequencies below 30 MHz and an electric field antenna at higher frequencies.[191] NTIA further recommends that an appropriate magnetic-to-electric field strength conversion factor be applied to enable correct comparisons of magnetic field measurements with the electric field strength limit, because a loop antenna measures magnetic field strength and the measurements are performed in the near-field.[192] In its

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[188] *See* Technical Appendix of NTIA Comments at § 3.

[189] *See* NTIA letter dated September 24, 2004.

[190] *See* NTIA Comments at vii and 20.

[191] The NTIA Comments modify the position in the NTIA Phase 1 Study regarding the use of a loop antenna below 30 MHz by concurring with the FCC proposed position.

[192] The issue here is the accuracy of the measured data. Most radiated emission specifications are given in terms of electric field strength (volts per meter), however, at low frequencies, the fields may be predominantly magnetic or electric. Many common antennas are more sensitive to one or the other type of fields; for example, dipole-based antennas are sensitive to electric fields but are not substantially affected by magnetic fields, which are sensed more readily by magnetic loop antennas. 47 C.F.R. Part 15 requires the use of a magnetic loop antenna below 30 MHz, because the Commission has found that calibrated loop antennas provide more accurate and repeatable field strength measurements below 30 MHz. However, the radiated emission limits are specified in terms of electric field, in volts per meter. To convert a measured magnetic field strength in dBμA/m to an associated electric field strength in dBμV/m in the far field region, one would add 20 log (377 ohms), or 51.2 dB, to the measured magnetic field strength.

comments, NTIA indicated that it was continuing to study the issue of an appropriate conversion factor; however NTIA subsequently informed the Commission that it has now completed those studies and has arrived at the same conclusions as we arrive at below.[193]

98. *e) Effects of Power Lines on the Radiated Emissions of BPL Devices.* NTIA found that its measurements and analyses show in most cases that peak field strength levels are not centered on the BPL device, and that multiple segments of the power lines and impedance discontinuities are the most significant BPL signal radiating elements.[194] Thus, NTIA recommends that BPL compliance measurements address both the BPL device and the power lines to which it is connected. It submits that field strength measurements should be performed at a 10 meter horizontal distance from the power line to which a BPL device is connected, and all along the connected power line wiring. Furthermore, because power lines have frequency selective radiation properties and BPL device frequencies are, or should be, tunable in frequency, NTIA states that Access BPL radiation characteristics are not uniform across all possible operating frequencies. Thus, to properly address frequency-selective radiation characteristics, NTIA recommends that measurements be made sequentially with the Access BPL devices operating at all frequencies at which they are capable; and should be accomplished using the maximum possible BPL device output power and operational duty factor.[195]

99. *f) Selection of Representative Installations.* In order to ensure that the highest representative field strength levels are measured and that these levels do not exceed the limits, NTIA further recommends adoption of guidelines for selection of the three Access BPL deployments for *in situ* measurements and a rule specifying how those measurements are to be applied. In its comments, NTIA does not address rules and guidelines for the selection of test sites. However, the NTIA Phase 1 Study specifies that 1) the BPL device should be located near the center of a straight section of power lines at least 600 meters in length that is devoid of significant impedance discontinuities; and 2) a variety of representative medium voltage (MV) power line configurations should be present in the test site; for example, the site should include single and three-phase power line segments, sharp turns in the power line, and risers that connect overhead lines to underground lines.[196]

100. *g) Other Requirements.* NTIA recommends that representative spectral power distributions of Access BPL signals be measured and included in the measurement report to facilitate identification of the BPL signals in the event they cause interference. NTIA also recommends that the locations and magnitudes of the six highest field strength levels measured at one meter height (plus 5 dB correction) should be recorded in the measurement report.[197] Furthermore, NTIA indicates that the measurement bandwidth to be used for testing BPL emissions, the measurement height correction, and the

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[193] *See* NTIA Comments at 20; *see also* letter of September 24, 2004 from Frederick R. Wentland, Associate Chief, NTIA Office of Spectrum Management, to Ed Thomas, Chief of the Commission's Office of Engineering and Technology, *supra.*

[194] *See* NTIA Phase 1 study, §5 and Appendixes D and E.

[195] For example, a BPL system that has 5 MHz bandwidth and can be tuned between 5 MHz and 30 MHz would be measured while tuned to 5 MHz, 10 MHz, 15 MHz...and 30 MHz. This principle should not be confused with the requirement to adjust measurement frequencies throughout frequency ranges specified in §15.33. *See* NTIA Comments at 21.

[196] *See* NTIA Phase 1 Study, §7.9.

[197] *Id.*, at 21.

measurement distances should be embodied in the rules and not merely as guidelines, as BPL compliance measurement provisions are deemed most important to limitation of interference risks.[198]

101. *Comments.* BPL providers strongly disagree with most of NTIA's findings and recommendations. Current states that NTIA's study is based on both computer simulations and field measurements of three distinct technologies of Access BPL systems, that these two types of studies did not yield consistent results, and that the discrepancies have not been reconciled. Current believes that a major weakness in the NTIA simulations is a set of starting assumptions that do not reflect actual Access BPL practice or specific system design or implementation. As a consequence, Current believes that any attempt to apply the NTIA simulation results to real-world BPL systems becomes inaccurate and unreliable. For example, Current contends that NTIA's simulations use a pure tone on the power line whereas real Access BPL uses a broadband signal having a far lower propensity to cause interference. Current further contends that while NTIA's simulations place the BPL signal on the power line by creating a differential voltage signal in the middle of the line, in practice that is all but impossible to do without cutting the line; and that, in reality, the couplers used by Current (and other Access BPL vendors) display very different characteristics, resulting in different propagation along the line. Current asserts that NTIA's interference model uses frequencies and line lengths that create a phase mismatch equal to 1/3 of a wavelength at each end of the line, thereby setting up standing waves; thus, the results are not representative of emissions from actual BPL devices using noise-like signals, which would not cause standing waves.[199] Finally, Current submits that each of NTIA's recommendations would unduly and unnecessarily burden BPL by impairing one or both of its core attributes for economic success, *i.e.*, transmission range and data capacity, because the proposals rest on NTIA's study which overestimates the interference potential of Access BPL.[200] Ambient Corporation (Ambient) also echoed the concerns of Current regarding NTIA's simulations and measurements.[201] Southern states that many of NTIA's conclusions appear to have been based on its computer modeling, which even NTIA concedes had to be simplified due to the number of variables involved in modeling an electric power system and the limits on computer access memory.[202]

102. Duke Energy also argues that NTIA's recommendations are overly burdensome and unnecessary. Duke Energy believes that NTIA's suggestions that measurements be taken at the center of lines at least 600 m in length, devoid of discontinuities, and measuring at a variety of representative lines are impractical. Duke Energy further disagrees with NTIA's recommendation that Access BPL be measured sequentially across the entire band of operations, because it believes that this will create excessive testing burden.[203] PPL Telcom states that it opposes use of the adjustment factor proposed by NTIA as an attempt to predict how measurements may increase with increasing height. PPL Telcom asserts that in its experience in deployment of Access BPL systems, it has found little and inconsistent increase in emissions with increasing height. It states that other factors in distribution power line construction, such as the type of construction, phase spacing, grounding configuration, age of equipment and type and number of electrical devices connected to the line appear to have as much, or more, influence on radiated

198 *See* NTIA Comments at 23.

199 Reply comments of Current Technologies at 18-19.

200 *Id.*, at 4-5.

201 Reply comments of Ambient at 3.

202 Reply comments of Southern at 26-27.

203 Reply comments of Duke Energy at 20-21.

emissions as measurement height. PPL Telcom also objects to NTIA's recommendation for measurements taken along distribution power lines that are at least 600 meters in length and devoid of impedance continuities because such lines are extremely rare and would make such a requirement impossible to fulfill.[204]

103. Progress Energy suggests that emission measurements should be performed with the Access BPL equipment power levels set for normal operations at the site being examined, not at the maximum levels as proposed in the *Notice*. Progress Energy also recommends that testing be performed during data transfer at a sustained rate that would be similar to, or slightly greater, than the expected usage at that site. It argues that performing the test with the equipment operating with the maximum power and duty cycle it is capable of generating, as proposed in the *Notice*, may not represent the normal operation of the equipment.[205] Progress Energy furthers requests clarification regarding how to test if the Access BPL equipment installed at a site is from more than one vendor, which vendor's equipment should be used in testing and should three tests be conducted for each vendor's equipment?[206] Ambient disagrees with NTIA's recommendation that a 5 dB correction factor should be added to emission measurement data taken with an antenna at one meter high. Southern disagrees with NTIA's recommendation that measurements be taken sequentially across the entire frequency range over which the BPL device could operate and states that such a requirement could greatly increase the costs of verifying BPL compliance without significantly improving the confidence that the device under test complies with the Part 15 limits.[207] Southern further states that once a network is up and operating, conducting sequential testing across a large number of frequencies would be extremely difficult due to the need to coordinate frequency usage among all the devices on the same line as the device under test. In fact, Southern states that it might be necessary to take the network down in order to conduct such testing; hence NTIA's proposals are overly burdensome.[208]

104. The UPLC advocates measurements on overhead installations parallel to the power line at various distances from each BPL device and on underground installations at various radials from the devices. The UPLC recommends that all measurements be taken in accordance with the Part 15 rules, at one to four meters above ground and at a distance of 10 meters away from the line. The UPLC specifically opposes measuring for peak field strength at every frequency all along the power line and taking measurements at the height of the power line, or alternatively, using an adjustment factor for estimated increased signal strength at that height.[209]

105. Ameren states that its main concern with any search procedure for finding the peak field strength along the line is the upper bound of the number of necessary measurements. Ameren agrees, however, in general terms with the NTIA's study findings concerning the field variability with respect to observation (measurement) height. Ameren has performed its own theoretical modeling and submits that its model shows that the maximum field seen from zero to 15 meters above ground at any distance from the BPL device along the line is at most 3.5 dB greater than the maximum field seen at 1 meter above ground at

[204] NTIA Phase 1 Study at 7-6, reply comments of PPL at 15. NTIA did not repeat this recommendation in the NTIA Comments, submitted after the NTIA Phase 1 Study.

[205] Comments of Progress at 3.

[206] *Id.*, at 4.

[207] *Id.*, at 39.

[208] *Id.*, at 40.

[209] Reply comments of UPLC at 23.

any distance from the BPL device along the power line.[210] Ameren therefore affirms that NTIA's proposed 5 dB height correction factor is close to Ameren's proposed 3.5 dB; and that until better correlation can be established, Ameren urges we to allow the more lenient factor of 3.5 dB proposed by Ameren.

106. In its comments, the ARRL concurs with our proposed measurement guidelines, but states that measurements should be made at a fixed 10 meter distance.[211] In its reply comments, the ARRL states that the 5 dB correction factor recommended by NTIA makes sense and that use of the 5 dB correction factor is a far simpler mechanism than to attempt to find field strength peaks at various distances from the lines and at various heights as well. The ARRL nonetheless believes that any combination of NTIA's well-intentioned technical operating requirements would still be insufficient to avoid widespread interference to Amateur Radio stations in residential areas, or in vehicles.[212] This concern is echoed in filings from individual Amateur operators.[213]

107. *Decision*. We find the extensive measurement and modeling efforts presented in the NTIA Phase 1 Study and the Technical Appendix to NTIA's comments to be highly useful in our efforts to develop appropriate measurement procedures for Access BPL. The scientific engineering in those submissions clarifies the interference potential of Access BPL on radio reception and the recommended techniques for measurement of Access BPL emissions provide us with a well thought-out plan on which to base our decisions on measurement issues. Our decision, discussed below, takes into account NTIA's research and adopts a modified version of its recommendations.

108. We find that our proposed measurement procedure for testing Access BPL systems including the presence and testing of all of their electronic components to be reasonable as each component is part of the Access system of that installation. We do not agree with Southern that the testing should be limited to three representative signal injection points.[214] Southern believes that the highest levels of emissions on overhead systems are found at the signal injection point, and it states that the biggest variable affecting emissions is impedance mismatch between the signal injection system and the power system at the point of injection, which could be a coupler or a repeater. We agree with Southern that each injection point affects the radiated emissions. However, Southern's suggestion of selecting only representative signal injection points precludes the presence of other components, *e.g.,* booster, concentrator, extractor, etc. if they should be together at an installation to make up the complete Access BPL system. Our requirement for a typical installation takes into account the topology of the power lines and of all Access BPL devices at that installation, thus choosing only representative injection points, as Southern recommends, does not cover the installation as a whole.[215] Accordingly, we will keep our proposed *in-situ* requirements for including and testing all components of an Access BPL system. We also find that our measurement procedure for testing Access BPL systems *in situ* at three typical underground locations along a number of radials consistent with testing other Part 15 carrier current devices. The selection of three typical underground installations is a streamlined procedure, compared to testing each and every installation, as

[210] Reply comments of Ameren at 5.

[211] ARRL comments at 25.

[212] Reply comments of ARRL at 24.

[213] *See, e.g.,* comments of David Garnier; Edwin S. Toal; John E. Matz; Richard E. Polivka; Thomas D. Cox, etc.

[214] *See* comments of Southern at 21.

[215] *See* 47 C.F.R. § 15.31(j) and (k).

recommended by some parties;[216] therefore we do not agree with Main.Net that only one underground location should be tested.[217] We discuss below the issues with respect to measuring radiated emissions from Access BPL systems on overhead power lines.

109. *Measurement Distance.* Despite the stated aversion of NTIA and ARRL to distance extrapolation, we recognize that at many *in situ* test locations, it may not be possible or practicable to measure at the proposed fixed distances of 10 and 3 meters. If a 10-meter distance places the measurement antenna on a roadway, safety may dictate increasing the distance to, *e.g.*, 14 meters in order to position the testers out of harm's way. Hence, we expect that distance extrapolation will be necessary for *in situ* testing. We note that NTIA's latest computer modeling results show that the variation of field strength with distance is consistent with the existing Part 15 distance extrapolation when used with the slant range distance to the power line as was proposed in Appendix C of the *Notice*. We also note that although the ARRL and ARINC recommend the use of a 20 dB per decade extrapolation factor rather than the existing 40 dB per decade in Part 15 for frequencies below 30 MHz, Ameren states that it has determined the characteristics of the fields near the line support the case for assuming a 40 dB per decade decay rate of the field away from the line and recommends the use of the existing 40 dB per decade extrapolation factor.[218] Given the lack of conclusive experimental data pending large scale Access BPL deployments, we will continue the use of the existing Part 15 distance extrapolation factors in our rules, but with the slant range rather than horizontal distance.[219] If new information becomes available that alternative emission limit/distance standards or extrapolation factors would be more appropriate, we will revisit this issue at another time.

110. *Receive Antenna Height and Correction Factor.* NTIA expresses a possible need for "adjustments" to measured data due to three factors: 1) effect of antenna height, 2) effect of distance (extrapolation methods), and 3) effect of using an H-field sensing antenna to predict E-fields in the near-field region. However, NTIA initially provided a specific recommendation regarding only one of these issues—correction for the effect of antenna height. Our modeling suggests that there is a linkage between these factors. We believe that all three areas must be considered together in order to develop appropriate measurement procedures. Furthermore, NTIA's recommendation for a 5 dB correction factor is based on a constant measurement antenna height of 1 meter. On the other hand, for frequencies above 30 MHz, our current measurement guidelines require varying the receive antenna height from 1 to 4 meters, hence higher peaks at a higher antenna height would be found with our test procedure, obviating the need for a height correction factor at those frequencies. However, we recognize that NTIA's method of keeping the antenna height constant and applying a height correction factor is aimed at simplifying the measurement procedure; hence, this might be an alternative testing procedure that BPL providers may actually prefer. The Commission's rules have historically allowed the use of alternative methods for compliance measurements, based on good engineering practices. In deference to NTIA's extensive work culminating in the NTIA recommendations in this proceeding, we will adopt NTIA's recommendations for antenna height and correction factor as an alternative method within the measurement guidelines of Appendix C. We note however that the methods are mutually exclusive, *i.e.*, the BPL tester must choose either the NTIA alternative method or the FCC method, and cannot mix and match the two.

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[216] *See e.g.*, comments of API at 9-10; reply comments of ARINC at 7.

[217] *See* comments of Main.Net at 9.

[218] *See* reply comments of ARINC at 2 and Ameren at 8; comments of ARRL at 15.

[219] *See* 47 C.F.R. § 15.31(f)(1) and (2).

111. *Type of Antenna Used for Testing.* Given NTIA's concurrence with the use of a magnetic loop antenna for emission measurements below 30 MHz and electric field sensing antennas above 30 MHz, we are adopting our proposal to use these antenna types in Access BPL emission measurements. This decision is consistent with the use of such antennas for testing other types of Part 15 devices.

112. *Effects of Power Lines on the Radiated Emissions of a BPL Device.* We are concerned that NTIA's recommendation for performing field strength measurements all along a 1200-meter section of the connected power line wiring would be difficult and burdensome for Access BPL system operation. In this regard, we note that such a process could be time-consuming and would require many individual measurements, when power wiring may be many miles long, and the interval between measurements may have to be a small fraction of a wavelength in order to ensure that the true peak is captured. It is clear from the modeling results presented by NTIA that the maximum emission from the system often occurs further down-line from the coupler than the one-wavelength maximum distance proposed in Appendix C of the *Notice*. However, it is also clear from the NTIA data that the true maximum is not significantly larger than the maximum that would be found over the limited search space that we proposed. We understand the concerns of Ameren, Southern, and other BPL providers regarding an overly large number of necessary measurements, which could increase the costs of compliance testing. We therefore believe that the approach in our proposed measurement guidelines strikes an appropriate balance in avoiding a potentially very large number of measurements by allowing the use of the mid-band frequency in determining measurement distances down-line for a given frequency band of operation. We also note that, at each of the five specified down-line points, measurements must be made at all operating frequencies of the Access BPL device, in order to find the peaks.[220]

113. We concur with NTIA's recommendation that measurements be made sequentially with the Access BPL devices operating at all frequencies at which they are capable. This is consistent with existing Part 15 requirements, and with our proposed measurement guidelines.[221] It is important that radiated emissions be measured at all operating frequencies to find the peaks.[222] We also concur with NTIA's recommendation that measurements be made using the maximum possible BPL device output power and operational duty factor. We disagree with Progress Energy that emission measurements should be performed with the Access BPL equipment power levels set for normal operations at that site, and not at the maximum levels.[223] Testing at the BPL maximum output power and operational duty factor is necessary to ensure identification of the maximum field strength that the device is capable of generating. The measurement report and operating instructions must clearly state the maximum output power and duty factor settings necessary to certify that the installed device will comply with our limits. However, because the same device might be used on either overhead or underground power lines having different radiating properties, we are not requiring that the device be modified to prevent operation at higher power levels and duty cycle settings. Furthermore, Access BPL devices must comply with our limits upon power-up following a fault condition, or during a start-up operation after a shut-off

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[220] The specified down-line points are at distances of 0, ¼ , ½ , ¾, and 1 wavelength down the line from the BPL injection point on the power line. Wavelength spacing is calculated based on the mid-band frequency of each operating frequency band used by the Access BPL device.

[221] 47 C.F.R. § 15.31(i) requires emission tests to be performed with the device and accessories configured in a manner that tends to produce maximized emissions within the range of variations that can be expected under normal operating conditions. Appendix C of the *Notice* proposed to require testing at all frequencies, but allows the use of five points based on the wavelength of the mid-band frequency

[222] *Id.*

[223] Comments of Progress Energy at 3. *See also* ¶102.

procedure, by the use of a non-volatile memory, or some other method, to immediately restore previous settings with programmed notches and excluded bands. This is necessary to avoid the situation where programmed protection schemes, such as excluded bands and notches, have to be restored manually, thus leaving protected licensed services vulnerable during the time delay caused by a manual re-programming procedure.

114. Based on the foregoing, we believe that our proposed measurement guidelines that require selection of fractional wavelengths based on mid-band frequency for down-line measurements strike an appropriate balance between the need to ensure compliance with the rules and practical considerations of the burden and degree of measurement difficulty placed on system operators, and that our requirements for testing at maximum output power and operational duty factor and requirement for clear identification of maximum compliant operating levels will ensure that devices comply under all conditions. Accordingly, we are adopting the measurement guidelines in Appendix C of the *Notice,* modified to incorporate some of NTIA's recommendations, as discussed *supra.*

115. *Selection of Representative Installations.* Although we concur with NTIA that the selection of typical Access BPL installations for *in situ* measurements must be made in a careful manner, taking into account the various configurations of the power lines to select a typical, representative installation, we will not require specific criteria for site selection process, because this may limit the number of test sites which may actually be more typical in a specific provider's service area than those recommended by NTIA.[224] We find that our proposed guidelines for three typical overhead installations and three typical underground installations are reasonable to cover a number of test sites in deployment.[225] We also find that by requiring Access BPL devices to be certified by the equipment manufacturer, the concerns of Progress Energy regarding Access BPL installation sites with multiple vendors' equipment no longer exist because the responsibility for site selection to test for equipment certification purposes rests with the Access BPL manufacturer and not with the utility.[226] We are however recommending that the utility operator verify that each representative Access BPL site complies following the installation of a separately certified Access BPL equipment. In such cases, the selection of the test site should be based on the characteristics of the installation and not on vendor's equipment types. Additionally, we concur with Southern and UPLC that NTIA's recommendation in the NTIA Phase 1 Study of requiring a representative power line of 600 meters devoid of discontinuities is impractical, because of the difficulty of finding such a line. Accordingly, in the absence of more specific input, we will not require the selection of such a specific type of power line.

116. *Other requirements.* We find that NTIA's recommendations regarding the various reporting requirements for the test report are satisfied by our adoption of the certification procedure for Access BPL equipment authorization, discussed *infra.*[227] Information regarding the test conditions, spectrum distribution and other relevant technical specifications will be required in the certification report for the equipment, which will be accessible through our equipment authorization database. We further find that NTIA's recommendation to embody requirements such as measurement distance, measurement

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[224] *See NTIA Phase 1 Study,* §7.9. NTIA recommends to select a test site with a variety of representative medium power line configurations, *i.e.,* the site should include single and three-phase power line segments, sharp turns in the power line and risers that connect overhead lines to underground lines.

[225] Appendix C, *Notice*, at §2.

[226] *See* comments of Progress Energy at 4. *See also* ¶103.

[227] *See* ¶124.

bandwidth, etc. directly into the rules and not merely as guidelines, would not be consistent with our current practice of including measurement specifications in a separate guideline.[228]

2. In-House Carrier Current Systems

117. In the *Notice*, we noted that the International Electrotechnical Commission (IEC), International Special Committee on Radio Interference (CISPR) Subcommittee I on *Interference Relating To Multimedia Equipment*, Working Group 3 on *Emissions from Information Technology Equipment* has been developing conducted emission limits for new BPL technologies.[229] We observed that this work on an international standardized measurement method for In-House BPL is still under way, including the definition of a line impedance stabilization network (LISN),[230] associated injection methods, and conducted emission limits for systems using the power line port as a communication port.[231] We proposed in the interim, pending the completion of such work, to retain the three-installation radiated emissions method for In-House BPL and traditional CCS, using the measurement guidelines in Appendix C of the *Notice*. We sought comments on using these guidelines for In-House BPL and other carrier current systems.[232]

118. The HomePlug PowerLine Alliance (HomePlug) supports application of the existing rules for *in situ* testing of In-House BPL and other carrier current systems, but disagrees with the proposal to require testing along the outside service lines at specified distances because it contends that in many instances it will be impractical to find test sites suitable for the proposed measurements.[233] HomePlug argues that the detailed guidelines would require test sites with low voltage service wires longer than 110 feet with 33 feet of clear space along both sides of the wire (66 feet total) for its entire length, and that finding such sites would limit choices of tests sites to those not necessarily representative of typical In-House BPL installations. HomePlug contends that application of the proposed test guidelines to In-House BPL systems with respect to the points along the service wires would be overly burdensome and serve no useful purpose.[234]

119. *Decision.* We note that although CISPR is continuing to work on addressing emission issues that will apply to In-House BPL, no final recommendation has been adopted.[235] We also note that most

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[228] *See e.g., Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, 18 FCC Rcd 24484 (2003).

[229] *Notice* at 47.

[230] A line impedance stabilization network (LISN) is an artificial power line network that provides a specified load impedance in a given frequency range. This device is also used to isolate the equipment from the AC supply and to facilitate measurements.

[231] *See* the work of IEC CISPR Subcommittee I on *Interference Relating To Multimedia Equipment*, Working Group 3 on *Emissions from Information Technology Equipment*, at < http://www.iec.ch/cgi-bin/procgi.pl/www/iecwww.p?wwwlang=E&wwwprog=sea1112.p&committee=CIS%2FI&class=&refno=&type=&date >.

[232] *See Notice* at ¶47 and *Notice*, Appendix C at 31-33.

[233] Comments of HomePlug at 1-2.

[234] *Id.*, at 6-7.

[235] CISPR is working on a committee draft (CD) for power line communications (PLC), but the draft is far from being finalized as an international standard. *See* http://www.iec.ch/cgi-bin/procgi.pl/www/iecwww.p?wwwlang=E&wwwprog=sea1112.p&committee= CIS%2FI&class=&refno=&type=&date=.

commenters in this proceeding address Access BPL, and not In-House BPL, issues. Measurements along the service wire leading to the house have been proposed because this wire can be one of the conduits for radiation coming from In-House BPL devices. We are sympathetic to HomePlug's concerns, however. To address HomePlug's concerns, we will allow measurements to be made at three different points along the wire, where the highest radiated emissions are found; these points would not need to be associated with specific wavelengths of the device's operating frequencies, if the installation under test does not include a service wire with a sufficient length for the required measurements.[236] Moreover, testing is required on only one side of the service wire because radiation is nearly symmetrical on either side of the wire. The test report must provide documentation explaining the test configuration. As for the required clear space along the service wire, the guidelines do allow the test to be performed at 3 meters with a distance extrapolation factor when a 10-meter clearance is not available, hence we would expect that most residence configurations would not pose any clearance problem. Accordingly, we partially grant HomePlug's request and hereby adopt the guidelines for In-House BPL and all other in-house types of carrier current systems in Appendix C of this Report and Order.

F. Equipment Authorization

120. In the *Notice*, we proposed to retain the Verification procedure for Access BPL equipment. Section 302 of the Communications Act of 1934, as amended, authorizes the Commission to make reasonable regulations, consistent with the public interest, governing the interference potential of equipment that emits radio frequency energy. Under Section 302, we establish technical regulations for transmitters and other equipment to minimize their potential for causing interference to radio services, and administer an equipment authorization program to ensure that equipment reaching the market complies with the technical requirements.[237] The authorization program requires that equipment be tested either by the manufacturer or at an independent test laboratory to ensure that it complies with the technical requirements. The authorization program specifies several procedures for demonstrating equipment compliance. The procedure to which a device is subject depends on the risk of interference that the equipment poses to licensed radio services.

121. *Certification* is an equipment authorization issued by the Commission or its designated entities[238] based on representations and test data submitted by the applicant.[239] *Declaration of Conformity* (DoC) is a manufacturer's self-approval procedure where the responsible party, who could be the manufacturer, the grantee or the importer of the equipment, as defined in 47 C.F.R. § 2.909, makes measurements or takes other necessary steps to ensure that the equipment complies with the appropriate technical standards.[240] The laboratory performing the measurements, either the manufacturer's laboratory or an

[236] In addition to testing radials around the building, testing for In-House BPL shall be performed at three positions along the overhead line connecting to the building (*i.e.* the service wire), where the maximum emissions are found. It is recommended that these measurements be performed starting at a distance 10 meters down the line from the connection to the building. If this test cannot be performed due to insufficient length of the service wire, a statement explaining the test condition and configuration shall be included in the technical report. *See* Appendix C, § 3(b)(1).

[237] *See* 47 U.S.C. § 302(a).

[238] In 1999, the Commission made changes to Part 2 of the rules to allow designated private organizations, called Telecommunication Certification Bodies (TCBs), to approve equipment in the same manner as the Commission, *see Report and Order* in GEN Docket 98-68, 13 FCC Rcd 24687 (1999).

[239] *See* 47 C.F.R. § 2.907.

[240] *See* 47 C.F.R. § 2.906.